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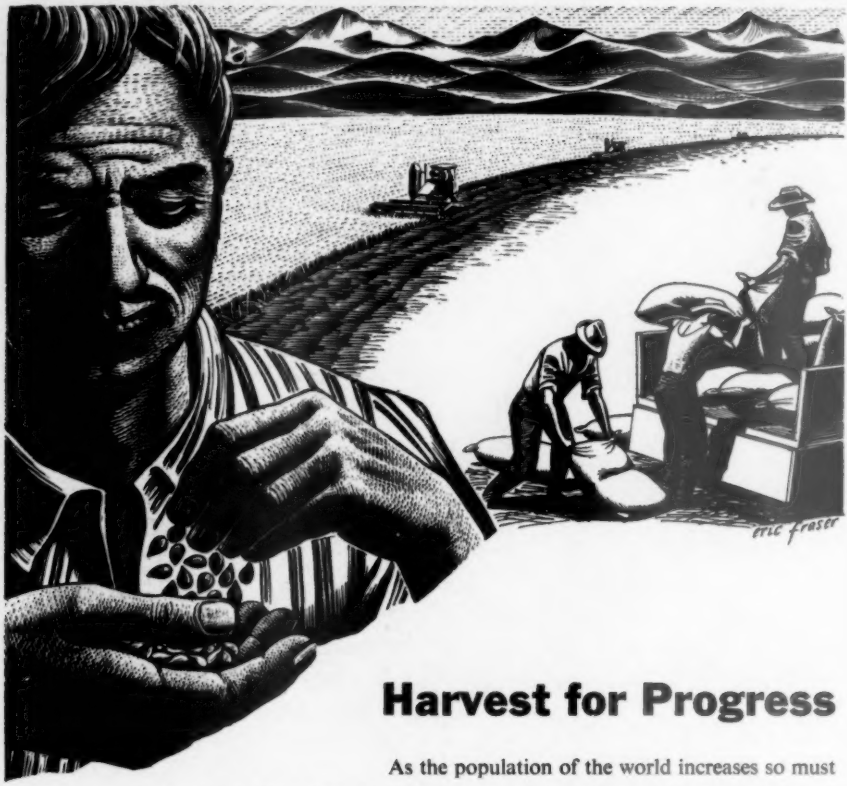

Harvest for Progress

As the population of the world increases so must the production of food. Forests must be cleared, marshes drained, deserts irrigated; the rival hunger of insects and weeds must be fought, the fertility of the soil restored and maintained. In all these tasks petroleum, source of power and lubrication for agriculture's machinery, of chemicals as farming's allies, is contributing to the greater harvest on which progress depends.

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Journal of the Royal Society of Arts

NO. 5021 APRIL 1958 VOL. CVI

FORTHCOMING MEETINGS

WEDNESDAY, 26TH MARCH, at 2.30 p.m. FRED COOK MEMORIAL LECTURE. '*Andrea Mantegna*', by Sir Kenneth Clark, K.C.B., Chairman, Arts Council of Great Britain. His Excellency Count Vittorio Zoppi, Italian Ambassador, in the Chair. (The lecture will be illustrated with lantern slides.)

MONDAY, 14TH APRIL, at 6 p.m. The first of three CANTOR LECTURES on '*Pre-stressed Concrete*', by G. W. Kirkland, M.B.E., M.I.C.E., M.I.Struct.E.

MONDAY, 21ST APRIL, at 6 p.m. The second of three CANTOR LECTURES on '*Pre-stressed Concrete*', by G. W. Kirkland, M.B.E., M.I.C.E., M.I.Struct.E.

TUESDAY, 22ND APRIL, at 5.15 p.m. COMMONWEALTH SECTION. '*Overseas Surveys*', by Brigadier Martin Hotine, C.M.G., C.B.E., Director of Colonial Surveys, and Surveys Adviser to the Secretary of State for the Colonies. Sir Hilton Poynton, K.C.M.G., Joint Deputy Under-Secretary of State, Colonial Office, in the Chair. (The paper will be illustrated with lantern slides. Tea will be served in the Library from 4.30 p.m.)

WEDNESDAY, 23RD APRIL, at 2.30 p.m. The first of three papers on '*British Trade*': '*Trade with Latin-America*', by Sir John Taylor, K.B.E., C.M.G., Director-General, Hispanic and Luso-Brazilian Councils. The Right Honble. Sir David Eccles, K.C.V.O., M.P., President of the Board of Trade, in the Chair.

MONDAY, 28TH APRIL, at 6 p.m. The last of three CANTOR LECTURES on '*Pre-stressed Concrete*', by G. W. Kirkland, M.B.E., M.I.C.E., M.I.Struct.E.

WEDNESDAY, 30TH APRIL, at 2.30 p.m. The second of three papers on '*British Trade*': '*Trade with the Commonwealth*', by G. S. Dunnett, C.M.G., O.B.E., Secretary, Commonwealth Economic Committee. Sir Patrick Hannon, Vice-President, Empire Industries Association, in the Chair.

WEDNESDAY, 7TH MAY, at 2.30 p.m. The last of three papers on '*British Trade*': '*Trade with Western Europe*', by Roger Falk, O.B.E., Managing Director, Marketing Development Co. Ltd., and Chairman, British Export Trade Research Organization Ltd. Major Sir Edward Beddington Behrens, C.M.G., M.C., Vice-Chairman, European League for Economic Co-operation, in the Chair.

Fellows are entitled to attend any of the Society's meetings without tickets** (except where otherwise stated), **and may also bring two guests. When they cannot accompany their guests, Fellows may give them special passes, books of which can be obtained on application to the Secretary.

THOMAS GRAY MEMORIAL TRUST

PRIZE FOR A DEED OF PROFESSIONAL MERIT

In recognition of the remarkable skill which is so constantly displayed at sea, the Council of the Royal Society of Arts, which administers the Thomas Gray Memorial Trust, offers again this year the Society's Silver Medal for a deed of outstanding professional merit by a member of the British Merchant Navy. The period to be covered by the offer will be the year ending 30th September, 1958, and deeds of a character worthy to be considered for the award may be brought to the notice of the Council by any person not later than 31st December, 1958. They will not, however, be considered by the judges unless they have been endorsed by a recognized authority or responsible person able to testify to the deed to be adjudged.

The Council reserves the right to withhold the above award at its discretion.

The prize of the Society's Silver Medal offered in 1957 for a Deed of Professional Merit was not awarded, as none of the submissions was considered to be sufficiently outstanding.

EXHIBITION OF BURSARY DESIGNS

The exhibition of winning and commended designs in the 1957 Industrial Art Bursaries Competition will be held in the Society's House from Tuesday, 6th May, until Friday, 23rd May. The exhibition will be open on Mondays to Fridays from 10 a.m. to 5.30 p.m., and on Saturdays from 10 a.m. to 12.30 p.m.

Special cards of admission will be required for the opening, which will be performed by Sir John Maud, G.C.B., C.B.E., at 12.15 p.m. on 6th May. It is expected that, although the majority of these cards must be issued to those who are directly concerned with the organization of the Competition, a number will be available for other Fellows. Those Fellows who are interested should apply to the Secretary by 29th April.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 10th March, 1958. Present: Sir Alfred Bossom (in the Chair); Mrs. Mary Adams; The Honble. G. C. H. Chubb; Sir Edward Crowe; Mr. P. A. Le Neve Foster; Mr. John Gloag; Sir Ernest Goodale; Sir William Halcrow; The Earl of Halsbury; Dr. R. W. Holland; Mr. William Johnstone; Mr. Edgar E. Lawley; Mr. F. A. Mercer; Lord Nathan; Mr. A. R. N. Roberts; Sir Harold Saunders; Dr. L. Dudley Stamp; Sir Stephen Tallents; Professor S. Tolansky; Mr. G. E. Tonge; Mr. Hugh A. Warren and Sir Griffith Williams; with Dr. K. W. Luckhurst (Secretary); Mr. G. E. Mercer (Deputy Secretary) and Mr. J. S. Skidmore (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Aldred, Miss Margaret Gertrude, East Molesey, Surrey.
Amson, Harry Reginald, N.D.D., London.
Arcier, Joseph William, New Canaan, Conn., U.S.A.
Bradshaw, Major Alexander George Noël, London, Ontario, Canada.
Butler, Lieut.-Col. Neil Coen, T.D., J.P., Hythe, Kent.
Canning-Freeman, Edward, Brighton, Sussex.
Chidson, Donald Montagu Gerard, M.C., London.
Clayton, Frank, A.T.I., Shipley, Yorks.
Conn, Percival William Henry, Liverpool, Lancs.
Creed, Mrs. Valerie Leopoldine Gisela, Croydon, Surrey.
Crowe, Miss Sylvia, London.
Durtnell, Geoffrey Douglas, Edenbridge, Kent.
Edmonds, Richard Clive, London.
Feesey, Joseph Jack, Chelmsford, Essex.
Fraser, Leslie Norman, A.M.I.C.E., Chelmsford, Essex.
Gomme, Austin Harvey, M.A., Cambridge.
Holmes, William, Pulborough, Sussex.
Jenkins, Gilbert Lawrence Martin, A.R.I.B.A., London.
Kamlish, Ivor Jack, London.
Kelly, Gerald John, A.R.I.B.A., Stevenage, Herts.
Kiralfy, Harold Graham, London.
Mbu, Matthew Tawo, London.
Onalaja, Moronkeji Omotayo, LL.B., London.
Pearson, Herbert, Scunthorpe, Lincs.
Pedel, Donald Raymond, N.D.D., High Wycombe, Bucks.
Pendlebury, Laurence Scott, Balwyn, Victoria, Australia.
Pleydell Bouverie, Miss Doris, J.P., Bury St. Edmunds, Suffolk.
Riley, Denis Wearing, Stafford.
Rose, Barry, Pagham, Sussex.
Saville, Leslie William Ernest, Sutton, Surrey.
Sharp, Thomas, C.B.E., M.A., D.Litt., Auckland, Co. Durham.
Stockwell, Frank Howard, London.
Ward, John Trevor, B.Litt., B.Sc., Wye, Kent.
Wheat, John Potter, Darien, Conn., U.S.A.
Wheatcroft, Mrs. Mildred Susan, M.A., London.

Wiggins, Leslie Frederick, D.Sc., Ph.D., F.R.I.C., Wargrave, Berks.
Wood, George Bernard, Leeds, Yorks.

The following were elected Associate Members as winners of Industrial Art Bursaries in 1957:

Brown, Douglas Hamilton, Kelso, Roxburghshire, Scotland.
Chalmers, Miss Sheila, St. Helens, Lancs.
Harris, Miss Jennifer, Westergate, Sussex.
Martin, Douglas Ivor, Peterborough, Northants.
Tucker, Raymond, Spalding, Lincs.
Wilkes, Roger George, New Malden, Surrey.

The following was admitted as an Institution in Union:

The Regent Street Polytechnic, London.

STAFF SUPERANNUATION SCHEME

A revised staff superannuation scheme, to come into effect on 1st April next, was approved.

ALBERT MEDAL

Further consideration was given to the 1958 award.

THOMAS GRAY MEMORIAL TRUST COMMITTEE

The recommendations of the Thomas Gray Memorial Trust Committee with regard to awards for 1957, and their proposals for 1958, were adopted.

R.D.I. JOINT COMMITTEE

The Council members of the R.D.I. Joint Committee were reappointed to serve for the next 12 months.

EXAMINATIONS

It was reported that 37,450 entries had been received for the Easter series of examinations as compared with 34,971 in 1957.

OTHER BUSINESS

A quantity of financial and other business was transacted.

MODERN RESEARCH INTO BEES AND BEE-KEEPING

A paper by

STANLEY GOODING, M.A., M.Sc., M.D., J.P.,

President, British Bee-Keepers' Association, read to the Society on Wednesday, 15th January, 1958, with L. E. Snelgrove, M.A., M.Sc., in the Chair

THE CHAIRMAN: The subject of bees usually raises only two ideas in the mind of an average person, namely 'honey' and 'stings'. Most of you here to-day, however, are well aware that bee-keeping, apart from its economical importance, has become a very broad and in some respects difficult subject of study, and that for a comprehensive knowledge of the bee one needs to be familiar not only with its life economy and management, but also with such related subjects as plant biology (particularly pollination), nutrition, genetics, and even therapeutics—to say nothing of the relevant use of applied mathematics and the physical sciences.

In Dr. Gooding, we have one who is a versatile lecturer, highly skilled in biological science. He is, as you know, a distinguished medical man with a scientific training and a long experience of practical bee-keeping. At the present time he is President of the British Bee-keepers' Association. It would be difficult therefore to find a man better qualified to deal with this extensive subject. I feel sure that he will have selected those portions of it which will be of the greatest interest to us all, and that you will find that he has the gift of explaining and expressing highly technical matters in language simple enough for all of us to understand. A feature of some of his lectures is that he occasionally puts a brake on people who run away with new ideas not fully supported by evidence. We may hear something of this in his lecture this afternoon.

The following paper, which was illustrated by lantern slides, was then read:

THE PAPER

Interest in bees and their behaviour certainly dates from the time of Aristotle. It probably goes back very much further, even to the beginning of agriculture itself, in the days of the Pharaohs. The reason for this is not far to seek: it is because the honey bee's colony is obviously an ordered community. The rules that govern this community are not clearly or fully known even at the present day, and yet it is believed that bees are creatures entirely of instinct and that their behaviour shows no evidence of intelligence whatsoever.

Whether bees are kept for the honey that they produce, or for the pollination of the fruit blossoms, it is clearly of advantage to the bee-keeper to know all that he can about the springs of the honey bee's behaviour, and to work 'with the bees' and not against them.

The last occasion upon which a paper on bees was read to this distinguished Society was in 1951 [1], and during these last seven years much interesting research work has been done and this has helped to throw light upon the behaviour of bees in the various phases of their activities.

It will be appreciated, at the outset, that three-quarters of the bee-keepers of this country live in towns, and in the suburbs of towns, and that practically all of these bee-keepers are amateurs. The number of men who make a living from their bees is very small indeed, and the number of whole-time research workers is even smaller. In spite of this, great advances have been made, and it is my intention to touch upon a few of these researches this afternoon.

Bee stings are familiar to us all, and our knowledge of bee venom, and its effects upon us, are topics of great interest to both the bee-keeper and others associated with bee-keeping. In recent years, it has become increasingly clear that, although most of us develop an immunity to bee venom, a few people, indeed, develop a hypersensitivity to it, and the conditions under which one or other of these effects occur has been closely investigated.

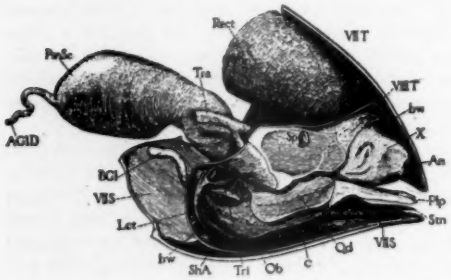

FIGURE 1. *The sting of the worker honey bee, together with the poison sac containing the venom of the sting. (After Snodgrass)*

The venom of the honey bee is produced by the 'acid gland' of the sting and it is stored in the poison sac until it is required. When it is required it is forced down the 'poison canal' of the sting into the puncture in the skin made by the two lancets of the sting apparatus itself (Figure 1). It is an interesting point that the sting of the honey bee is an adaptation of the ovipositor of the solitary bees, and this has been made possible by the fact that worker bees do not, under normal conditions, lay eggs and so do not require an ovipositor.

Each bee yields about 1/3 mgs. of venom and this is strongly acid[2]. The chemical composition of the bee venom is not completely known, but it contains, among other constituents, five substances which give rise to pain and swelling when injected into the skin, and which are responsible for the effects of a bee sting. These substances are:

1. A protein, or proteins, one of which, melittin[3], has not been found elsewhere than in bee venom.
2. Free Histamine. Reinert extracted, from 1 gramme of venom, 10 mgs. of histamine[4].
3. 5-Hydroxytryptamine. This substance when injected has, itself, a histamine-like effect, and in addition, it causes the cells themselves to liberate more histamine. It causes, too, a liberation of heparin from the cells and this may, in its turn, account for the occasional haemorrhagic effects of a bee sting.
4. Hyaluronidase.
5. A crystalline substance, chemically related to curare[5].

Bee venom has been examined through the electron microscope and by means

of paper partition chromatography, with the result that its chemical composition is now established. Histamine seems to be at the basis of the reaction of a bee sting. The histamine may be in a free state or liberated locally by the tissues themselves, or by the allergic reaction induced in the victim by the injection of the foreign protein. This histamine is made to spread through the tissues of the skin, to a greater extent than it otherwise would have done, by the action of the hyaluronidase. If the victim is particularly susceptible to histamine, or the histamine is produced in unusually large amounts, then the victim is said to be hypersensitive.

The histamine liberator, 5-hydroxytryptamine, liberates histamine from certain cells in the body, known as 'Mast cells', and these in their turn vary in number according to the health of the individual. In this way we see why a person should be susceptible to bee stings at one time and not at another according to his health.

A knowledge of the chemical composition of bee venom points the way to the best methods of treatment of bee stings. The newly discovered antihistamine drugs such as promethazine, antazoline and their allies, are the obvious antagonists to the histamine, and bee-keepers would be wise if they took a tablet or two of these antihistamine substances half an hour or so before attending to their bees. Cortisone, too, will protect one against the more severe effects of a bee sting.

For a more profound reaction to a sting in which the patient becomes unconscious, an injection of adrenalin is required. This can be administered, very expeditiously, by anyone in the company of the unconscious victim, by means of a 'fool proof' syringe of adrenalin solution, known as an 'Ampin'.

It will be realized, of course, that a case of unconsciousness or even death, as the result of a bee sting constitutes 'news', whereas the normal reaction to a bee sting in the hundreds of thousands of other cases passes unnoticed. The newspapers take full advantage of the news value of deaths from bee stings.

The Registrar-General's figures for the category 'Accidents due to the stings or bites of venomous animals or insects' for the six years 1949–54 are as follows:

1949	1950	1951	1952	1953	1954
10	2	4	5	6	3

It has to be remembered, however, that there is nearly always one death due to a snake bite during the year, to say nothing of the bites or stings of animals or insects other than bees. We should probably not be far from the true figure if we were to assess the risk of death from bee stings, in the population of these islands, as about 1 in 50 million.

There is no doubt that part of the generalized effect of a bee sting is due to the injection, into the body, of a foreign protein. It is interesting that this foreign protein is not confined to the sting apparatus of the bee. It was shown by Pepys[6], who tested the effects, upon hypersensitive people, of bees which had had their stings extracted, that hypersensitivity was still very strong. I have myself, in two cases, injected people, hypersensitive to bee stings, with a watery extract of macerated drones, and have provoked severe reactions of exactly the same type as with bee stings. Drones, of course, have no stings, so that in these

cases it must have been the general bee protein which provoked the sensitivity. Again, there are those bee-keepers, hypersensitive to bees, who when they merely look into a colony of bees, suffer a severe reaction even by first drawing aside the quilt, without indeed being stung at all.

It is within the knowledge of beekeepers that the stings of bees at certain times of the year are worse than at other times. Indeed, it is quite apparent that bee stings are worse when bees are at the heather than when they are at the clover. Why this should be is far from being understood. An experiment which was carried out by Phisalix several years ago has a bearing upon this point. He found that a single sting was sufficient to kill a small frog. If the bees, however, were confined in the dark and fed entirely upon sugar and water, without honey, then it took four to five stings to kill the same sized frog. It would appear, therefore, that the potency of the bee venom varies in different bees according to their environment.

There has been reported, during the last year or two, cures of blindness by bee venom, and also its use in the treatment of rheumatism. Apart from the strong psychological effect of treatment by bee stings, it is most unlikely that bee venom has any objective medical value in these cases, although in the treatment of rheumatism there may be some slight justification for the treatment. Indeed, the orthodox treatment of some varieties of rheumatism has always been an injection of protein into the sufferer, with the object of producing a protein shock. This causes a dilatation of the blood vessels in the region of the joints, and presumably the increased blood supply overcomes the rheumatic disease. The bee venom, as we have seen, contains protein and this, when injected, may have some effect in rheumatism.

Reactions to the sting of a wasp appear to differ little from reactions to the sting of a bee except in the matter of secondary infection. It has to be remembered in this connection that, unlike bees, wasps and hornets are carnivorous and scavengers, so that secondary infection is more likely to occur through the puncture hole made by their stings than with the honey bees[8].

A discovery of great significance to bee-keeping was made by Butler[9] in 1954, when it was shown that worker bees in a colony continuously licked the body of their queen, and so passed on to other worker bees in the colony regurgitated food containing a substance known as 'Queen Substance'. This Queen Substance appeared to act as a chemical messenger or signal to the colony that the queen was satisfactorily present in the colony, and therefore their swarming was inhibited. The chemical composition of this Queen Substance is still unknown, but it has been shown to be present, or something similar to it, in several arthropoda, such as the prawns and shrimps, and also in the ants.

In passing this Queen Substance around the colony bees seem to use a method of cohesion for the colony itself, so that if the supply of Queen Substance is sufficient there will be no splitting of the colony by swarming, neither will there be a queen supersedure. Extracts of this Queen Substance have been painted on to worker bees and, in the absence of a queen in the colony, it has been

passed round within the colony by the other worker bees, and, in this way, swarming can be prevented.

There are indications that this Queen Substance is a steroid, and the elucidation of its chemical structure should soon be established.

The method of dancing upon the combs adopted by bees has caught the public imagination in recent years. It was shown by Von Frisch, several years ago, that when a forager bee returns to the hive it does a dance, and by this means it communicates to other bees in the hive the distance and direction from the hive in which the forage is to be found. Thus the returning bee dances around on the combs, a few cells to the left and then a few cells to the right, and as it comes across the diameter it waggles its abdomen from side to side. The number of tail-wags indicates the distance away from the hive that the forage is to be found, and the angle this diameter makes with the vertical, indicates the direction in which the forage is to be found.

The position of the sun in the sky is used by the honey bee to assist it in its navigation, and in this it makes use of its compound eyes, which in their turn are sensitive to polarized light. It is now known, of course, that several other insects have eyes which are sensitive to polarized light, and use is made of this fact to help them in their navigation.

This work has been taken a stage further during the last two years by Lindauer, working in Munich. Lindauer has been observing swarms of bees hanging upon trees and bushes, and has noticed that the scout bees dance upon the surface of the swarms. This has, of course, been noticed before, and it has been assumed by bee-keepers that the scouts are indicating to the swarm a desirable final home for the bees. This assumption is fortified by the fact that scout-bees have commonly been observed flying around apiaries, apparently inspecting likely places in which a swarm might finally settle. Lindauer has been able, with a stop watch and a sextant in his hands, to measure the components of these dances and so, by this vigour and direction of their dances, foretell possible places to which the swarm may finally decamp. Quite clearly, bees from different sites in the neighbourhood would be giving different information to the swarm.

The important point of this research work is that Lindauer has been able to show that only when the dances upon the surface of the swarm become the same—or in other words, only when the information given to the swarm becomes unanimous—does the swarm, in fact, leave for its final resting place.

How this degree of unanimity was achieved, Lindauer was quite unable to ascertain. It seems, however, that there must be some sort of 'parliament' among the scout bees by which the minority must yield to the majority, and eventually unanimity is established. This would seem to constitute a degree of choice among the scout bees which is quite surprising.

In one of Lindauer's experiments a swarm had chosen a site of 800 metres away and, as a result, the swarm had to fly over a railway marshalling yard in order to get there. Freely translated, Lindauer's words are as follows:

> The swarm got to the railway marshalling yard during a traffic mix-up, flying only two or three metres above the ground, and the swarm was scattered

> by the numerous cars. A quarter of an hour later, they had reassembled under the porch of a shop, and very soon the scout bees were dancing on the surface of the swarm, and now they were showing only 300 metres as the distance to be covered. The distance already covered was 500 metres, and so it would seem that they had made the deduction from the 800 metres from where they had started, and so had only 300 metres to go.

Lindauer goes on to say:

> Perhaps more experiments should be made upon this problem, and an attempt might be made to ascertain whether the 300 metres was calculated afresh by the scout bees from the new resting place.

This is a very remarkable result, and should it be confirmed, it must indicate that a good deal of choice has been exercised by the scout bees in leading a swarm to its final home. Now, this raises once again the whole question of instinct or intelligence in bees. Are bees creatures governed entirely by instinct, or does their behaviour show any sign of intelligence?

Lindauer's recent work, mentioned above, tends to indicate that Fabre's view of this question was, perhaps, a little too inflexible and that bees do show, in some aspects of their behaviour, a degree of choice very much akin to intelligence. Of course, the distinction between instinct and intelligence is largely one of definition; for how do we define instinct, and what do we mean by intelligence?

Let us begin, then, by defining instinct. Behaviour that is governed entirely by instinct is a pattern of behaviour that commences at the beginning and goes through to the end, and if it is interrupted in the middle, it is impossible for the animal to take up the behaviour pattern at the point at which it was interrupted. On the other hand, behaviour that is governed by intelligence is behaviour that is adapted to the end in view, such a situation not having been met with before by the animal. We can see that the ingredient of instinctive behaviour is a fixed pattern, whereas that of intelligence is one of flexibility, a continual adaptation to the animal's environment. The characteristic of the higher animals is the gradual dawn of intelligence as the governing force in their behaviour, and that intelligence seems to reside, anatomically, in the grey matter of the brain; this is found in the cerebral hemispheres.

The cerebral hemispheres and 'intelligence' are very recent evolutionary developments, found particularly in mankind and the higher apes. Mankind has been upon the earth for possibly one-third of a million years, whereas the honey-bees go back in evolutionary history to 90 million years ago (Table I). Let us look for a moment at the brain of the honey bee (Table II, p. 310) to see whether there is any part of it which corresponds with the grey matter of the higher animals. The brain of the honey bee consists largely of cells concerned with vision, the sense of sight. But there is a part of the brain known as the 'Mushroom Bodies', and these are, in fact, covered by nerve cells which correspond with the grey matter of the cerebral hemispheres of higher animals; these cells are called Purkinje cells. If an examination of the problem of instinct or intelligence in bees reveals that their behaviour might be considered to show some intelligence, then there is an area of the brain, namely, the Purkinje cells

TABLE I

THE GEOLOGICAL AGE OF BEES COMPARED WITH OTHER INSECTS

	Period	*Earth Age*	*Move-ments*	*Fossils*	*First Appearance of Insects on the Earth (in millions of years)*
KAINOZOIC	Pleistocene	1/20 million years ago	—	Origin of Man	
	Pliocene	15 ,,	—		Perfect Specimen of Bee in Baltic Amber 50
	Miocene	35 ,,	—		
	Oligocene		Alpine	Rise of Mammals	
	Eocene (sand)	60 ,,	—		Butterflies 60
MESOZOIC	Cretaceous	70 ,,	—	First True Birds	
		90 ,,	—	Flowering Plants	Honey Bees 90
	Jurassic	100 ,,	—	Toothed Birds	
		110 ,,	—	Age of Reptiles (winged)	Flies 110
		150 ,,	—		
	Triassic	205 ,,	—		
PALÆOZOIC	Permain	205 ,,	Hercynian		Beetles 250
	Carboniferous	300 ,,	Caledon'n	First Fish (flying)	Dragonflies 300
	Old Red Sand	400 ,,	—		Grasshoppers etc. 350
	Silurian		—		
	Ordovician	450 ,,	—		
	Cambrian		—	First Fossils	Extinct orders as Fossils
	Pre-Cambrian	575 ,,	—		

The earth's crust cooled down to the temperature of tepid water, sufficient for life to commence, 2,700 million years ago.

where that intelligence may reside. The rest of the central nervous system of the honey bee consists of a nerve chain running down the ventral side of the insect's body. The nerve chain is punctuated by seven ganglia. A feature of the central nervous system of the bee is that there is not complete centralization of function in the brain, but that the ganglia in the nerve chain can act autonomously if the brain is severed from the rest of the central nervous system.

When the brain of the bee is dissected and isolated from the rest of the body, it is found to consist of at least three parts. The first is that concerned with the

sense of sight through the compound and simple eyes. Another large portion of the brain is that concerned with the sense of smell, localized in the antennae. When allowance is made for the proportion of the brain taken up by these senses, we are left with areas in the front part of the brain, between the simple eyes and the compound eyes, which, as I have already mentioned, are known as the Mushroom Bodies. If we look at the brain of the worker bee, the queen bee and the drone, we find that the Mushroom Bodies in the worker bee are relatively more highly developed than in either the queen bee or in the drone. This is very largely what we should expect, since the queen bee lives a life of seclusion within the hive; the drone has only one effective function, that is the fertilization of the queen, whereas the worker bee has always to perform work which is most varied and difficult. The workers, then, have Mushroom Bodies which are most highly developed. It might be said that, in this sense, the order of intelligence in the three casts of bees is workers first, queens second, and drones last. Some very interesting work has been done by Alten[10] in which he measured the volume of the Mushroom Bodies in various species belonging to the order, Hymenoptera. A part of his result is shown in Table II.

TABLE II

Brain Index of	Queen of Bombus Agrorum	3.138
	Worker of Bombus Terrestris	3.133
	Queen of Vespa Vulgaris	3.074
	Worker of Bombus Agrorum	3.018
Below Index 3:	Worker Apis Mellifera	2.572
	Queen Apis Mellifera	2.526
	Drone Apis Mellifera	2.455
Lowest Index:	Drone of Solitary Bee Andrena Fulva ...	2.034

From this we notice that the honey bee, Apis Mellifera, does not come at the top of the list. It is found that the queen bumble bee and the queen wasp come before the honey bee, and, in this way, might be considered more intelligent than the worker hive bee, if the Mushroom Bodies are taken as an index of the insect's mental development. We notice, too, that the social insects are at the head of the list and that the solitary bees and wasps come much lower down in the list, and last of all is the male of the solitary bee, known as Andrena Fulva. It is, I believe, a general rule in the insect kindgom that the males are far less intelligent than the females!

It is, of course, necessary to observe the behaviour patterns of animals in order to decide whether or not they show intelligence, and in a later part of this paper certain aspects of the behaviour of both honey bees and their cousins, the solitary bees and wasps, will be described, to see whether they show any glimmer of intelligence. In the meantime, let us examine some of the senses of bees; and, in the first place, we might refer again to the sense of sight. We know that bees can see, although their vision is, compared with ours, somewhat short-sighted. They can see colours, although they are unable to see so well at the red end of the spectrum as we can ourselves. On the other hand, there is some compensation

for this defect in that bees are able to see further into the ultra-violet than we can ourselves. That sight plays a great part in the activities of the honey bee is shown by the large areas of the brain that are concerned with the sense of sight.

We know also that bees have a sense of smell, and this has been proved by Von Frisch who, in 1923, showed that the sense of smell in bees is about as acute as in ourselves, and is derived from the last eight segments of the antennae. More recently, Von Frisch has amplified his work on the sense of smell in bees, and has shown that a high degree of communication occurs among bees in the hive, and the sense of smell plays a large part in the 'Language of Bees'.

The pollen and nectar dances also enable bees to learn the direction in which their forage is to be found. Elements of the dance also indicate the distance from the hive in which the nectar is to be found.

Two other senses possessed by bees are, I venture to say, not conspiciously possessed by ourselves. They are, a sense of direction flown, and also a sense of distance flown. This last, of course, is independent of the clock. This sense of direction and distance flown, possessed by bees, was the subject of considerable interest to J. H. Fabre. Fabre used mason bees, and on one occasion he took his mason bees no less than three miles from their home and released them from their containers in a dense dark copse. He was surprised to find that the mason bees were able to fly that three miles home through the wood in spite of the fact that they were not able to see the horizon. Fabre wondered whether this homing instinct in the bee resided in the two antennae. In consequence, he snipped off the antennae of a few mason bees and released them in the wood, but they found their way home, over a distance of three miles, just the same. It was suggested to Fabre by Charles Darwin that this homing instinct in bees was derived from a magnetic sense, so Fabre attached very small magnets to the underside of his bees and repeated the experiment. In spite of this, Fabre's mason bees found their way home just as before.

This sense of direction is no less awe-inspiring because we know that it is possessed, in a high degree, by many other animal species. We have only to remember the homing instinct of the pigeons, the migration of birds, and similar behaviour in cats and dogs, to realize that this sense is not peculiar to the insect world. Another attribute of the bees and wasps is their capacity for memory. One has only to consider the peculiar behaviour of the solitary wasp, Pompilus, which catches its spider before it digs its burrow and marks, by a remarkable feat of memory, the position of the spider, to realize that memory plays a most important part in the behaviour of these insects. Figure 2 depicts the sand

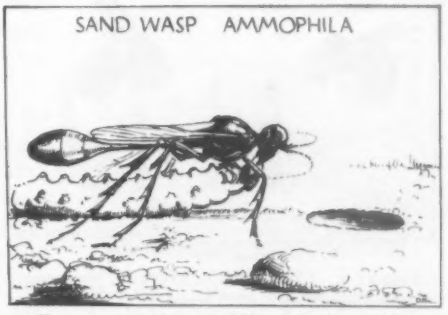

FIGURE 2. Ammophila Sabulosa, *the sand wasp.* (*Drawing by Dorothy Hodges*)

wasp, Ammophila; this wasp seems to exhibit in its behaviour the beginnings of choice and, possibly, a glimmer of intelligence. The sand wasp digs its burrow by using its jaws as mining tools and its front legs as rakes. It burrows into the sandy soil for a few inches and, every now and then, it comes across a little stone. The wasp takes great care to remove, from the sight of its operations, all the debris that it has thrown up in its diggings; all the small stones and pebbles that it comes across, it puts to one side. It finishes its burrow by gouging out the top portion with a slightly greater diameter than the deeper recesses of the burrow. Having done this, it then selects one of the pebbles which will fit exactly into the mouth of the burrow and places it in position, and if the evening is fast approaching, it will cover up the whole area with sand. The insect does this so effectively that it is impossible for the human eye to detect where the underlying burrow is to be found. The intention of the sand wasp seems to be to hunt its prey on the following day when the sun is high up on the horizon. For the rest of the evening it goes off, nobody knows where, to await the dawn for its hunting expedition. The prey that the sand wasp will search for is the grey worm. This grey worm is the larva of a certain moth, and is to be found around the roots of thorn bushes. The wasp hunts the worm in very much the same way as a terrier hunts a rabbit. When the worm emerges upon the surface, the sand wasp falls upon its prey and, according to Fabre, stings it in each of its thirteen separate segments. Gripping the worm in its mandibles, the wasp stands astride it; and although it may be as much as one hundred yards from its burrow, the wasp makes a straight line from the scene of its hunting to the burrow which it made the previous evening. Having located the burrow, it removes the sand, pushes the paralysed caterpillar into the burrow, lays its egg upon it, fills up with sand and then flies away. Indeed, there is one variety of Ammophila, viz., Ammophila Hirsuta, which actually picks up a stone and, using it as a ram, forces the sand down into the burrow, and eventually leaves the surface of the sand so smooth that it is impossible for the human eye to locate the position of the insect's operations. This is truly remarkable behaviour, and one might see in it many elements which could be considered examples of choice, and perhaps of intelligence. It is an example, also, of an animal using a primitive tool for its work.

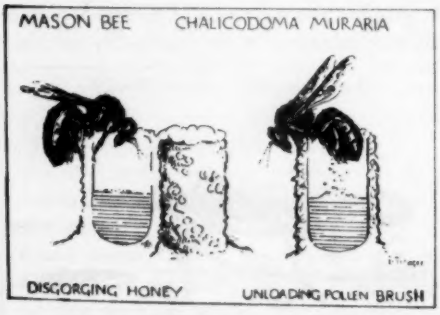

FIGURE 3. Chalicodoma Muraria, *the mason bee—illustrating its instinctive behaviour pattern in filling its cell with nectar and pollen.* (*Drawing by Dorothy Hodges*)

Against this, however, is the behaviour of mason bees while filling their cells with pollen and nectar, as described by Fabre. (Figure 3.) The mason bee arrives at the partially empty cell and, putting its head into

the cell, disgorges the nectar which it has collected; and then, turning round, it puts the end of its abdomen into the cell to brush off the pollen grains, which it has collected into a load on the underside of its abdomen. This action of the mason bee is constant and may be considered to be an instance of pattern behaviour.

Fabre describes how he interrupts this pattern in the middle. He flicks the bee away when it is about to put its abdomen into the cell to brush off the pollen. Fabre was very interested to see what would happen next. Would the bee fly back, having been brushed away, and resume the pattern of its behaviour at the point at which it was interrupted? Fabre found that it did not do this: it started the pattern all over again. Every time that the bee went to put its abdomen into the cell to brush off the pollen grains from the underside of its abdomen, Fabre flicked it away again with a straw; and every time the mason bee flew back and went through the pattern from the beginning once more. This type of behaviour seems to be common among the bees and the wasps and insects generally; their actions are performed according to a definite pattern, and if this pattern is interrupted, the insect has to begin all over again in order to finish it.

The works of J. H. Fabre are full of instances of this kind, and he was, in fact, convinced that bees had no intelligence whatever, but acted entirely by instinct.

Another striking instance described by Fabre is the behaviour of the mason wasp, Pelopaeus. Pelopaeus feeds upon a small, plump spider called the cross spider. This wasp hunts its prey and brings the paralysed spider to its cell and lays an egg upon it. It seems that its intention is to collect about fifteen or twenty spiders for the benefit of its newly hatched larva, and then to close its cell before building another one. This is another pattern reaction, and in a manner similar to that with mason bee, Fabre plays a trick upon this wasp. With a pair of forceps he removes the first spider, together with the egg upon it, and watches to see what Pelopaeus will do. Ignoring the disappearance of the egg and its first spider, Pelopaeus duly brings along a further fifteen or twenty spiders, and each of these, in turn, is removed by forceps by the observant Fabre. At the end of this time, the wasp seals up its cell in spite of the fact that the cell is quite empty of the egg and spiders. This action seems once again to be an instance of instinctive behaviour, and shows no mark of intelligence.

The activities of the leaf-cutter bee, Megachile, and the carpenter bee, Osmia Rufa, will repay study from the point of view of instinct and intelligence.

The cells of the leaf-cutter bee are made from rose leaves which are cut out to the exact dimensions of the insect's cell. This the insect does with its mandibles and rolls round the leaf to make a cell, in the shape of a small barrel (Figure 4). It furnishes the cell with sufficient pollen and nectar, and lays an egg on top of the pollen and nectar

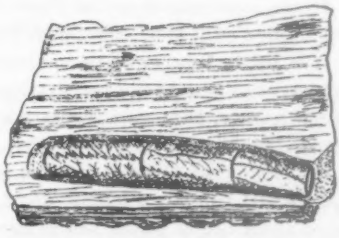

FIGURE 4. *Three cells of leaf-cutter bee* (Megachile) *in a piece of rotten wood.* (*Drawing by Dorothy Hodges*)

before closing up the cell with more layers of rose leaf. It will be seen that the rose leaf cuttings of the outside layers have to be a little larger than the inside layers, and this is allowed for by the leaf-cutter bee. One of the most versatile of our native solitary bees is Osmia Rufa. This bee often makes its cells of mud in snail shells and in the cavities of decaying tree stumps. In fact, it has been known to make a nest inside an actively used railway sleeper. A feature of the cells made by Osmia Rufa is that small cells are used for male eggs and large cells for female eggs. It would seem, therefore, that the bee is able to arrange to lay either a male egg or a female egg, according to the size of the cell in which the larva is to be nurtured. In fact, by arranging for Osmia Rufa to make its cell in a space of very limited dimensions, Fabre could make Osmia Rufa lay fertile female eggs or infertile male eggs, at will.

It has often been considered by bee-keepers that the size of the drone cell, as compared with the size of the worker cell, is the determining factor in deciding whether a worker egg or drone egg is laid by the queen. This idea would, of course, be borne out by Fabre's experiment on Osmia Rufa. Nevertheless, the modern view is that the size of the cell is not responsible for the queen laying a fertile or an infertile egg; but rather that this is determined by something which we might call the 'Hive Mind', and this, in its turn, indicates the needs of the colony itself. Many of these examples of instinctive behaviour have, of course, been drawn from the lives of the solitary bees. Recently, as mentioned above, some work has been carried out by Lindauer, in Germany, upon the behaviour of dancing honey bees on the surface of a swarm. This rather points to honey bees being able, on occasions, to exercise a certain degree of choice which might be considered intelligence.

The last topic that I want to touch upon this afternoon is Royal Jelly, the material upon which the queen bee is fed from the beginning of her life.

The chemical composition and physiological effect of Royal Jelly upon bees and upon mankind has been intensively investigated during the last few years. Indeed, remarkable claims have been made in newspaper advertisements in France, Spain and Italy as to the rejuvenating properties of Royal Jelly, as well as in the United States of America and in Latin-American countries. A typical advertisement is shown in Figure 5.

It was reported, also, that Pope Pius XII, during his serious illness in 1954, was treated with good effect with Royal Jelly.

It is partly because of these claims that I decided, myself, to investigate the properties of Royal Jelly and to make some experiments upon myself, upon some of my friends, and upon laboratory animals. Firstly, then, let us see why it is that it should even be thought that Royal Jelly has these wonderful properties. The basis of the belief is, of course, that the queen bee, which is fed entirely upon Royal Jelly, lives for two and a half years; whereas the worker bee, weaned on to a mixture of pollen and nectar from Royal Jelly on the third day of larval life, lives only some three months in all. It would seem therefore that the queen bee's longevity is due to feeding with Royal Jelly and (so the argument runs) when this is given to human beings, they too should live longer. It is not very

clear, however, why it should be thought that what is good for an insect is necessarily good for a human being!

FIGURE 5. *An example of a continental advertisement for Royal Jelly.* (*Reproduced by kind permission of* Jean d'Albret, Parfumeur, Paris)

Let us inquire into the chemical composition of Royal Jelly. This has been worked out very fully and exhaustively. Royal Jelly is a very acid, opalescent, material with a sour taste in the mouth, whose p.H is 3·4. It is very rich in pantothenic acid, a component of the vitamin B_6 complex. Indeed, some authors claim that it is the richest animal source of pantothenic acid in nature. On chemical examination Royal Jelly is found to contain proteins, fat, carbohydrate, mineral salts and vitamins, and traces of other constituents. It is peculiar in the fact that it does not contain vitamins of any other group except the B group, and that vitamin B_6 is present in very high concentration. Hormones too are

absent, or, at any rate, those that we have looked for—mammalian sex and growth hormones.

It would seem, therefore, that the presence of large quantities of pantothenic acid in Royal Jelly might be responsible for the production of a queen if the jelly is fed to a bee larva before it is two and a half days old, and continues to be fed to the queen until the commencement of pupation. Adding pantothenic acid, however, to the larval food of a worker bee has never produced a queen, although it has been shown to cause some ovarian stimulation in the worker bee.

What is suggestive, however, is that if one analyses the Royal Jelly and estimates the amount of pantothenic acid on different days of the queen larva's development, it is found that the concentration of pantothenic acid is at a maximum just at the time of the differentiation between the queen and worker larva, namely, at two and a half days. At this time the pantothenic acid content of the Royal Jelly amounts to 600 Mgrs./per 1 gram dried weight, whereas it falls off rapidly after this, and by the fifth day it is 160 Mgrs./per 1 gram of dried weight of Royal Jelly.

The pantothenic acid content of the food of workers and drones never rises above 170 Mgrs./per 1 gram dried weight, and it, too, falls off rapidly from the third day to the sixth day of larval life[11 12 13].

It has been found, of course, in other biological experiments that, where growth and differentiation of tissue is progressing rapidly, then larger and larger quantities of pantothenic acid seem to be required for this differentiation of tissues. This is well known in tissue culture work. Indeed, it has been found that the developing chick embryo will not survive in tissue culture unless the nutrient fluid contains a high concentration of pantothenic acid. This applies to the rapid division of cells not only in tissue culture, but also in the growth of yeasts and many bacteria.

The pantothenic acid is not directly concerned in the differentiation, except in so far that metabolism is progressing at a very great rate and energy is being required; pantothenic acid, then, seems to be a necessary accompaniment to the energy requirements of metabolism.

The proteins of Royal Jelly are not unlike those of cow's milk, and it might have been expected that the amino-acids found in Royal Jelly would have been rich in ß alanine, because of this substance's chemical relationship to pantothenic acid. And this has, indeed, been found to be the case: pantothenic acid seems to be synthesized from ß alanine in the honey bee.

It is known that certain pollens stimulate the brood food glands[14] and prolong the length of life of nurse bees. It has been shown, too, that several pollens will achieve this result, among them the dandelion pollen. It happens, moreover, that dandelion pollen does contain ß alanine, as indicated by the paper partition chromatography method of Consden, Gordon and Martin[15].

The pantothenic acid molecule contains a molecule of ß alanine, and one might have expected that if pantothenic acid had anything to do with the longevity of the nurse bees, then pollens that were rich in ß analine would produce longevity in nurse bees. This has been found to be the case.

As regards the longevity that is alleged to be produced in mammals by their being fed on Royal Jelly, I have carried out a large number of controlled experiments in which rats, mice, rabbits and toads have been either fed upon, or injected with, Royal Jelly, and in no case has evidence of longevity been obtained. Neither has evidence of a growth hormone been obtained in hypophysectomized rats.

In an attempt to identify the presence of a mammalian sex hormones in Royal Jelly, ovariectomized mice were used and the vaginal smear methods employed, but no evidence of the presence of mammalian sex hormones in Royal Jelly was obtained.

To sum up, then: it seems that pantothenic acid, in high concentration, is required at the time of queen differentiation and the rapid metabolism associated with the development of the queen larva. The pantothenic acid concentration, at about the second or third day, is at a maximum in Royal Jelly, but it seems possible that the pantothenic acid is not directly responsible for the production of a queen, but is associated only with the rapid metabolism and tissue development that is required for the production of the queen.

Feeding Royal Jelly to human beings will, of course, constitute feeding a diet rich in pantothenic acid. Human beings, however, are never short of pantothenic acid in their metabolism, because the bacteria in the alimentary canal can, and do, synthesize it, as and when required. Indeed, I have myself taken Royal Jelly, by mouth and by injection, and given it to unsuspecting patients by injection, and as far as one can ascertain, without any observable effect. Of course, it may be that we shall live longer—say, to be 150 years of age; but that remains to be seen!

It has been shown then, that the last few years have seen much research into bees and bee-keeping and, although there have been advances in the study of many more facets of the life of the bee than I have been able to touch upon this afternoon, it is clear that knowledge of bees and bee-keeping is making considerable progress and is throwing a great deal of light upon animal behaviour in a much wider field of biology.

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DISCUSSION

MRS. V. M. CHILTON: Is it possible for a queen in the swarm to pipe and attract the attention of other bees in another swarm?

THE LECTURER: That is possible.

MRS. CHILTON: Is this the behaviour of intelligence or instinct?

THE LECTURER: That is more difficult to answer. Usually the queen that pipes is the virgin queen, and I do not know that there is any evidence that the piping of the queen calls together bees from anywhere. If you have got a piping queen upon a comb, and you take it out of the hive and look at it, you will probably find it is a virgin queen piping, and you will notice that the worker bees standing on the comb all seem to crouch down as though in response to a warning sign of some kind. I do not know of any evidence which points to the piping of a queen, or the sense of hearing in any form, calling together a part of a swarm.

THE CHAIRMAN: I should think the piping of a queen in a divided swarm would be one of hostility, not attraction.

DR. COLIN BUTLER: I believe that in some of his work Dr. Lindauer has shown that bees who found certain highly desirable places for a new home danced very much more vigorously than bees who found less desirable places. The bees who found a very desirable place—which I think we can compare with a very rich source of nectar; something very desirable—apparently danced longer and more vigorously than the bees who had found the less desirable places, and so tended to recruit more bees than the others. Such recruits visited the source indicated, and, on returning home, danced in their turn. As it has been shown that bees who are working a crop, a source of food, can be recruited to visit a richer source of food by the vigorous dances of other bees, one may in this way get a shift across to the more desirable places, and it could be entirely automatic. What would be very interesting, from a practical point of view, would be to know far more about the characteristics that make a particular home very desirable to bees. What is the desirable home to the bee?

Dr. Gooding interested me very much indeed in his discussion of bee venom. I am one of the unfortunates who are extremely sensitive to bees; and I am sensitive to the whole bee. I get 'hay fever' badly in the summer months, which has been shown to be due to the whole bee, but not at all to the venom. You can pump venom into me as much as you like and it has practically no effect at all, but if a bee walks about or comes into contact with me, it has an effect. It seems to me that the two types of sensitivity can be quite separate. I think Dr. Gooding suggested that they were very similar. I am not so sure. I simply mention this as a possibly interesting line of research—I am quite willing to be a guinea pig, if it is of any use.

THE LECTURER: This is most interesting, as one would expect from Dr. Butler. I am delighted that he is willing to be a guinea pig, since he is one of the not very common hypersensitive people; and if I could get together a sort of 'rogues' gallery' of hypersensitive people amongst whom I could include Dr. Butler, I should be very happy.

About Lindauer: as I understood it, he did try, in fact, to find out what it was that made these particular homes attractive to a scout, but was not successful. I entirely agree with Dr. Butler, that if we did know, it would be an immense advance. It might be automatic, but at the same time you can do a lot in conditioning animals for food, and what Lindauer has said refers not to conditioning to food, but to places favourable for a swarm to rest in. You can condition animals to food, but rarely can you produce a conditioned reflex to other things. You cannot, of course, produce in bees a conditioned reflex to sound at all, and until we know what these qualities are that the scout bees are going out for, and bringing back, I am not sure that we can say that it can be explained on instinctive grounds alone. That is my answer. The difficulty is, that if a number of factors are involved, how is the scout bee going to be persuaded —there is no other word—that the sum of other scout bees' advantages in a resting-place outweighs the advantages of his own?

DR. BUTLER: Lindauer claims that quite a lot of the bees that are dancing—say there are three groups of bees dancing—do visit one another's sites. He claims that

the bee that finds the best site (which, as I have said, I think we can equate with the richest nectar) dances the most vigorously and is unlikely to be influenced in any way by the dances of her sisters who are dancing about other sites. But they are liable to be influenced by more vigorous dancers than themselves and will apparently go off and visit the sites which the more vigorous dancers are indicating—or about which they are talking, if I may put it that way.

MR. B. S. BOWERS: Is there any reason why there should be any relation between the vigour of a dancing group and the properties of the site they choose? I suggest that the selection of the site is random. The relative vigour of dancing groups is a result of their individual temperaments and not of the qualities of the sites they select.

I have another point: surely the whole process of going from A to B is not one instinct: there is no reason why they should not stop half way, unless you consider the whole process to be one instinct.

THE LECTURER: Your first point is an interesting one. I think that if the choice was made entirely at random, the bees would suffer and swarms would not survive. The fact that they manage to get a place where they are able to survive, develop and keep dry and so on—all the factors that a swarm needs—confirms that if they did not do that they would very soon be eliminated by natural selection.

MR. BOWERS: I agree; but surely there are some basic qualities required in scout bees, who would obviously go to a cavity? As regards the choice of cavities, that is random.

THE LECTURER: I am not sure that I quite follow that, but let us turn to the other point, which was the going half way wasn't it? I am not sure whether you are referring to bees going from a hive to a site of honey or nectar, going the whole way and coming back again, having the sense of direction and distance flown. Is that what you are referring to?

MR. BOWERS: Yes, in principle.

THE LECTURER: The dance on the swarm before they start indicates that they were going 800 metres. Well, this railway marshalling yard was 500 metres from their point of departure, and the swarms (which were, I think, about three metres above the ground) came upon these railway lines in the course of their flight, and the whole swarm split up, the bees reformed in an entirely different place and hung from the porch of a cottage. In other words, they stopped 500 metres from the point where they started; and then Lindauer looked and estimated the scout's information on the surface of the swarm hanging from the porch, and it indicated another 300 metres. The instinct was for 800 metres, not for half way.

MR. BOWERS: That is the point, isn't it? Whether in fact it is an instinct for the whole of the act terminating at 800 metres, or whether it terminates once the swarm is in the air?

THE LECTURER: Well, yes, that explanation might be as good as mine.

MR. T. BRADFORD: I live east of the Malvern Hills, something in the region of 700 to 1,000 feet above sea level. During the summer months it is quite common for a swarm of bees to come to the hills, travelling into the shade and then falling out to rest. Next morning, at eleven o'clock to half past, they will get up and go back in the opposite direction, towards the sun, from which they came.

THE LECTURER: You mean they rest there for the night?

MR. BRADFORD: They rest at the foot of the hills in the night because it is very cool; but the next morning they go back in the direction from which they came—back towards the sun again.

THE LECTURER: I have always considered honey bees respectable. Bumble bees will spend the night out, but honey bees do not as a rule. You are suggesting that these are foragers?

MR. BRADFORD: No, travelling swarms, and that raises the point of direction set out for but not achieved.

MR. G. A. TAYLOR: Dr. Gooding mentioned Queen Substance. Has Dr. Butler any further evidence of where the Queen Substance comes from, or what glands are secreting it?

DR. BUTLER: We have no further evidence.

WING COMMANDER G. D. D. GAMMACK: As one who suffers from bee stings at the beginning of the season and only becomes immune towards the end of it, may I ask whether any research is being directed towards elimination of the bad characteristics in the venom, or to producing stingless bees?

THE LECTURER: I do not think it is due to stingless bees or the increased elimination of the venom. I think it is that the body manufactures what is called anti-bodies, as the summer goes on.

WING COMMANDER GAMMACK: Will it ever be possible for research-workers to alter the characteristics of bees so that the whole bee population becomes stingless, or unable to inject venom?

THE LECTURER: Anything is possible in bee-keeping. I would take that to be quite hypothetical. Nothing along those lines has developed so far in bee-breeding. I personally would deplore it, because I think part of the fun of bee-keeping is in accepting the challenge that you must try to avoid being stung!

MR. J. L. HURFORD: May I ask Dr. Gooding if the position of the sting makes any difference? My late brother was once stung on the side of his head between his eye and his ear. I got the sting out, and within a few seconds he had completely collapsed. It took the doctor about three quarters of an hour to bring him round, after two injections. My brother must have been stung at other times during his long life spent in the country, but in this instance he became unconscious, and when the doctor came the next morning, he said to him, 'I think more of you to-day than I did yesterday'.

THE LECTURER: That is a very interesting point. I think the position of the sting does make a difference. I have just been reading the paper read by Miss Jex-Blake, written in 1943, and she gives details of a great number of cases of hypersensitive people, many of whom died as a result of stings; and one is struck by the fact, I think, that nearly all of them were stung about the head and neck. As far as I have been able to ascertain in the cases that have been reported in the last few years, such fatalities result, nearly always, from stings about the head and neck. Why this is so, is another matter altogether.

MR. C. H. WALKER: Would Dr. Stanley Gooding admit that on his return from Vienna, where he read a scientific paper at an international conference of nearly 1,000 bee-keepers, he reported that the Pope was treated with Royal Jelly?

THE LECTURER: I can put that much more exactly. It is true that in 1954 Pope Pius XII was reported to have been given some Royal Jelly by his physician during the course of an illness, and he recovered. I have said nothing more than that. I merely repeated what has been reported about Pope Pius XII. I have never said that Royal Jelly had beneficial effects, or that it was given with benefit to His Holiness.

MR. WALKER: Is it not true that there have been many reports of beneficial results obtained through the use of Royal Jelly?

THE LECTURER: Yes, but its administration to the Pope was not really a proper therapeutic test.

MR. WALKER: You suggested that although it was acknowledged that Royal Jelly had remarkable properties, it had yet to be proved that its benefits could be passed on to the human race. Did not results prove that the benefits of Royal Jelly could in fact be passed on?

THE LECTURER: I have not said anything of the kind: I must add that my interest in Royal Jelly is only scientific, not commercial.

MR. WALTER J. ABEL: Since the effect of feeding Royal Jelly to one of the cells produces a queen bee which is very much inferior to anything else in the hive, what should we expect to be the effect on some of us here, if we were served with Royal Jelly?

THE LECTURER: There is no limit to our expectations! I do not know. We should remember that in the first fifty years of this century the expectation of life for the average person has increased by twenty years. At the beginning of this century the expectation of life was 43 years for a man; now it is 63. This is very largely due to improved social conditions and to the advancement of medicine.

THE CHAIRMAN: One thing we have learnt from Dr. Gooding's lecture is that we are not in much danger of dying from a bee sting. The statistics say so. It is a comforting reflection.

With regard to his comments on the use of Royal Jelly for human beings, we should agree with him that many of the claims made for it in recent literature and advertisements are not supported by scientific experiment, and that therefore we should not be misled by them. On the other hand, I feel that we are not entitled to reject entirely the large amount of published evidence that some improvements in health have followed the administration of Royal Jelly to human beings. In this connection I may be allowed to refer to the recent views of a Dr. Decourt, a French investigator who considers that apparent improvements in health are not attributable to 'the few gammas' of vitamins in tiny doses of Royal Jelly, but are probably due to a constituent of the jelly which he calls 'Factor R'—not yet isolated—which in infinitesimally small amounts acts as a catalytic agent accelerating metabolism. This theory seems feasible and in accord with Dr. Gooding's remarks about pantothenic acid.

I now have great pleasure in proposing a hearty vote of thanks to Dr. Gooding for his admirable lecture.

The vote of thanks to the Lecturer was carried with acclamation.

MR. E. M. RICH: Before we separate I am sure we should wish to thank Mr. Snelgrove for so ably conducting our proceedings this afternoon. We have been fortunate in having a scientific expert in the keeping of bees in the Chair.

The vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

THE MARRIAGE OF ART AND SCIENCE

SOME MODERN IMPEDIMENTS TO A BALANCE OF POWER

A paper by

A. R. UBBELOHDE, M.A., D.Sc., F.R.S.,

Professor of Thermodynamics, University of London (Imperial College of Science and Technology), read to the Society on Wednesday, 29th January, 1958, with Robin Darwin, C.B.E., Principal, Royal College of Art, in the Chair

THE CHAIRMAN: As I rise to introduce this paper on the Marriage of Art and Science, I cannot help wondering, when I look at the upturned faces before me, on which side of the fence you stand—which of you, so to speak, are apes and which are angels. Not long since no one would have doubted which species belonged to which profession, but to-day all that is changed. Scientists have become not only angels but almost destroying angels, particularly in the field of thermodynamics which Professor Ubbelohde adorns. And, of course, we have all heard recently how apes have begun quite literally to take the bread out of artists' mouths.

To those of you who are scientists, Professor Ubbelohde needs of course no introduction; to those of you who are artists, I should perhaps say that not only is he in the front rank of scientists in this country, but he is also a collector of paintings and *objets d'art* of all kinds, and that he has a wide and deep knowledge of English literature. He is, in fact, a most cultivated person and for that reason some time ago we persuaded him to join the Council of the Royal College of Art in order to promote, if not a marriage, at any rate a mild flirtation between art and science. It has been a most satisfactory *affaire*. From every point of view, therefore, Professor Ubbelohde is well-suited to promote the union which he is now about to debate.

The following paper was then read:

THE PAPER

In one way or another most of us feel a present and urgent need to do something to control the growing powers of science. A century ago there was no such feeling. Our Victorian forebears, if so inclined, could laud the beneficence of scientific enlightenment without having to wage more than frontier wars with other claimants also bringing their gifts to man. In the federation of principalities and powers that make up our western civilization—religion, philosophy, history, politics, economics, art and science—though fierce squabbles were to be reported one hundred years ago, no one power really threatened to swallow up all the rest at that time. Probably this would still be true now, but for the material changes which are being brought into our lives at ever-increasing rates, through applied science. To see this, one need not only think of horrible

thermonuclear destruction, of ruthless tampering with human integrity in brain washing and worse, or of potentialities of tyranny far more pervasive than any recorded heretofore. Even our pattern of peaceful living, with its ever-increasing dependence on energy slaves, its ever-increasing incorporation of a multitude of achievements of applied science to ease our material burdens, and its ever-increasing and sometimes quite novel claims on human psychic energies, may in the long term prove disastrous if not properly guided and controlled. Shifts of technological supremacy are taking place from one country to another and even from one continent to another. These add national urgency to world-wide problems. What is to be done about the growing power of science over human lives?

Certain possibilities can be rejected at the outset. Unlike Samuel Butler in *Erewhon*, we cannot contemplate 'stopping the growth of science'. This growth is one of the undoubted splendours of our time. We cannot even contemplate 'stopping the growth of applied science'. Indeed, some of the middling and muddling troubles that beset us in Britain actually arise from inadequate applications of science, through a contemporary defect of inspiration, or through the actions of ancient immovable ones up and down the country whose obtuseness may cost Britain its leadership.

As a start, what can be done is to survey those human activities that enter into the balance of power between the various elements of civilized life. In the particular context of this lecture, we may examine how the balance of claims on human attention is to be maintained level between Art and Science. The choice of the title 'the marriage of Art and Science' is only partly fanciful. In a language more familiar to art than to science, marriage does conveniently symbolize a form of union which combines mutual integrity with strong mutual influence. The otherwise untamed virility of Science is to be guided and softened as it were by union with Art, to the greater advantage of man. In the brief space of one lecture this union can be plausibly regarded as highly desirable, but subject to grave impediments. These impediments will be considered in their personal, social and educational aspects.

Ideally, the most intimate union between art and science might be expected when both kinds of activity are found at the creative level, in the same individual. Practically, one obvious modern difficulty to this kind of union within one person stems from the ever-increasing scope of Science, and the ever-increasing accumulation of human experience in Art. Human beings who can be significantly creative in both Art and Science should be harder to find in our own time than in the past, when the scale of knowledge was more restricted. In following this line of inquiry backwards into history, the field of study may for practical reasons be restricted to western civilization. From the Greeks down to contemporary folk, the number of eminent leaders or even of prominent men who influenced both the art and science of their time by personal creation is notoriously small. In Western history, there have been periods of intense and often very successful human activity, tolerably free from those major conflicts or disasters that drain away human psychic energies in other directions.

These periods can be run through quite briefly in the search for leading personalities who can in any sense be described as having achieved creative work in both art and science. Despite the interest of the Greek philosophers in some of the elements of æsthetics and of science, it can be maintained that they would have made poor art patrons, and often poor experimental scientists as well. Plato quarrelled with the poets, and seldom if ever made Socrates choose an art creation by means of which to tease philosophy out of his hearers. Like the Elizabethans, the Greeks encouraged the practice of music in education, but no extant biography points to any real duality of creativeness in Art and Science at that time. Though the Romans were great patrons of art, much the same applies to them. The medievalists offer a more hopeful field for successful duality, but we are only just beginning to rediscover their scientific interests and so cannot be very definite. It seems very likely that the artist engineers of the Italian Renaissance had medieval precursors even if no clear records can be found.

Considerable information is available about the activities of Italian and other artists from the thirteenth to the sixteenth centuries, both in Giorgio Vasari's catalogue, and in individual biographies. Thus the father of Benvenuto Cellini (*c.* 1500) was an able mechanical engineer as well as an ardent musician. Vasari makes no sharp distinction between the pursuit of mechanical and civil engineering, of architecture, and of pictorial arts. He mentions (in the Life of Taddeo Zucchero) a contemporary Roman academy for the study of Vitruvius, whose treatise comprehends mechanical and civil engineering as well as architecture. Though the number of engineers referred to by name in Vasari's *Lives* is understandably smaller than the number of painters, the list includes prominent men such as: Francesco di Giorgio (1439–1502), sculptor and engineer; Il Cecca (1447–88), engineer; Andrea dal Monte S. Savino (1460–1529), sculptor and cosmographer; Baldassarre Peruzzi (1481–1537), who had a whole school of architects, engineers and instrument-makers amongst his pupils; Agostino and Agnolo (*ob. c.* 1350 and 1348), whose activities included sculpture, architecture and even plumbing and hydraulics; and Brunelleschi (1377–1446), who constructed some most impressive machines, both for building purposes and for dramatic shows.

In Vasari's life of the most outstanding artist engineer, Leonardo da Vinci (1452–1519), the passing remark is made that the extraordinary quickness of this man of genius may explain why he finished so little. This in itself points to one of the impediments to a personal union of art and science in individuals. An over-teeming creativeness in too many fields hinders effective realization in any one of them.

Among men prominent in the scientific Renaissance of the seventeenth century, Sir Christopher Wren (1632–1723) shows certain parallels with Leonardo da Vinci. We are mainly familiar with Wren's creations as an architect. But Thomas Sprat, who wrote a history of the Royal Society (1667) almost contemporary with its foundation, attributes a remarkably wide range of activities to this most gifted architect and applied scientist. Sprat's list of Wren's activities

with artefacts physically smaller than new buildings includes various metereological instruments, lenses of forms other than spherical, instruments of respiration for straining the breath from fuliginous vapours, ovens and incubators with controlled temperatures, water cocks, and various methods for keeping the motion of watches equal, for longitudinal and astronomical uses.

For what follows, it is important to note that these instances of successful plurality of activities were in the fields of the arts and the applied sciences. The Italian artist engineers were inventors, sometimes as in the case of Leonardo da Vinci inventors of genius, but they did not rationalize their knowledge into pure science as we now understand it. Pure science as an empire of the human mind describing creation is essentially aloof in its basic attitude. It aims to replace concrete experience by abstractions. Psychologically it may even be true that the practice of intense concentration and abstraction which is necessary for the pursuit of pure science tends to atrophy other human faculties, such as the appreciation of beauty. Charles Darwin complained that his power of appreciating poetry grew progressively less, due to his preoccupation with more abstract aspects of creation.

By contrast, applied science like art deals with concrete human realizations. For both, success is measured by objective constructions based on natural law, beauty or harmony. Any close correspondence on which a marriage can be based must be between art and applied science, not art and pure science. Thus there seems to be no reason to believe that Wren was specially gifted or prominent in dealing with scientific abstractions. As a Fellow of the Royal Society he would have been in close touch with contemporaries more inclined towards pure science, so that his creative genius could be effectively strengthened in both applied science and in art.

Since the time of Wren, there have been few if any applied scientists whose duality of creativeness has been at all comparable. It is not necessary to discuss them in detail. The conclusion seems clear that any union between art and science can only very rarely lead to effective creativeness of individuals in both fields. Any continued interaction and union between art and science must be on a different basis.

What this basis must be can be grasped from the modern effort to extend the divorce between art and applied science. In this divorce art is to take refuge in expression purged of all imagery, or relation to concrete reality, and applied science is to be starkly functional in all its creations. It would not be possible to run through all the past changes of view about art and technology that have led to this contemporary breach. Until the tide of science was running really strongly, philosophical views about art have followed certain broad ideas about beauty and the pleasure obtained by contemplating it. For example, there are the well known passages in the *Summa Theologiae* of St. Thomas Aquinas (1225–74):

> The beauty of the body consists in a man having his bodily members well proportioned, together with a certain appropriate clarity of colour. [II. (2) cxiv. 2]

> Beauty and goodness are inseparable, for they are based on the same thing, namely the form; and hence what is good is praised as being beautiful. But they are distinguishable; since the good concerns desire and is what all desire, and is therefore conceived as the end, for desire is a kind of impulse towards something. But beauty concerns our cognitive faculty, for those things are called beautiful whose sight pleases. So beauty consists in due proportion, since sense delights in things duly proportioned as in things like to itself. For sense is a kind of correspondence, and so is every power of cognition. And since cognition is by assimilation (of the knower and the known) and assimilation is of the form, beauty belongs strictly to the category of the formal cause. [I. v. 4]

> The beautiful coincides with the good but is distinguishable. For since the good is 'that which all things desire', it follows from our definition of the good that in it desire should be satisfied. But it is implied in the definition of beauty that by its very sight or recognition desire should be satisfied. Wherefore those senses are most concerned with beauty which are most concerned in apprehension, namely the sight and hearing, which minister to reason. For we speak of beautiful sights and sounds, but do not give the name of beauty to the objects of the other senses, such as tastes or smells. Thus it is clear that beauty affords to our faculty of knowledge something ordered, over and above the good; so that what simply satisfies desire is called good, but that whose very apprehension pleases is called beautiful. [II. (I) xxvii. I]

Intellectual claims made by science and by philosophies such as positivism, derived from it, threatened to submerge neighbouring kingdoms of civilization in the nineteenth century. Despite much subsequent growth, contemporary science is now more ready to recognize its theoretical insufficiency for satisfying the non-material needs of mankind. The modern conflict between art and science really stems not so much from intellectual claims as from the stupendous growth of material power conferred by applied science.

It would take far too long to examine all the meanings that have been applied or that can be attributed to the terms 'art' and 'applied science'. Instead of attempting this, one can seek for working definitions, without claiming that these are exclusive. On these lines, the artistic urge may be described as a creative human reaction to experience. Creative, since art must involve the transformation of matter of some kind, and its ordering to a human purpose. Human, since this particular form of reaction to experience, even if ultimately conveyed to many, has its beginnings and growth within a single human individual, the artist. And reaction, since art involves the imposing of a human purpose on matter which before the artistic creative act was innocent of such purpose. Matter can have a considerable degree of permanence, such as stone, bronze, glass or plastics; or its form can be more transitory, as clay, butter or plasticine. Matter subjected to an artistic creative purpose can even be as fluid as the sound that dies as soon as it is born; or (to be generous) as the blended scents and skilfully concocted flavours that can bring such great financial rewards to those that deal in such perishable experiences. We may accept as the result of much trial and controversy that, although the human purpose imposed on matter by artistic creative effort is an ordering 'disentropic' purpose, the artistic creation that results need not be conventionally beautiful, *id quod visum placet*.

In the appropriate setting the educational and astringent purposes of uglification are substantial. Nevertheless, the great bulk of human art will tend to respond to the need for beauty and harmony in arts' paymasters.

The growth of power over matter through applied science has affected the modes of action of art in a number of ways. Technological progress has amplified the range of human experience very greatly. Some of this experience must ultimately lead to novel artistic reaction. Looking into the Universe, looking down a microscope at the smallest forms of life, sharing in the material conquest of sea and air, or living in huge massed dwellings, are examples of forms of experience with little past history. Nothing suggests that these newer forms of experience resulting from technological progress will ultimately prove less digestible for the artist than much older forms, though there may be a time lag before they influence artistic creation.

However, in addition to providing new kinds of experience, technological progress has had a more subtle influence on artistic techniques. In the past, the artist's struggle with matter was conditioned by his limited powers in controlling it. As a consequence, artistic re-creation mostly retained a fairly close kinship with the artist's immediate experience of creation. This has as a benefit that such art could be and can still be generally understood by many with little power of abstraction from reality. Now it is so fatally easy to construct mere replicas of experience, by various applications of science, that some artists lean over backwards to avoid anything like intelligible imaginery in their creations. The effort to run away from any mere mirror of experience may be essential, to leave room for the artist's re-creative purpose. But the flight from intelligible imagery has its penalties, like other forms of escapism. There is the penalty, which some artists would regard as trivial, that fewer and fewer people can absorb such artistic creations. A more serious penalty is that the stark functionalism of applied science can find no adequate opposition from abstract art such as might lead to a balance of powers. The notion that only stark functionalism can any longer be justified or even tolerated in the applications of science to the various needs of civilization implies a complete divorce between art and science. But why should our power stations be more than naked boilers, furnaces and tubes? Why should our dwelling-places be more than cells, our seats more than curves fitted to the human frame, to be reproduced in their millions in metal or plastic sheets, our tables conveyor belts from home kitchens or even from a mass kitchen, our drinking vessels tubes joined to some centralized pipe-line, and so on? Surely all the comfortable uses of civilized life are functionally quite unjustifiable? Why should the large blocks of offices which house those whom some consider to be the real rulers, the chartered accountants, be more than large boxes conveniently sub-divided, sound proofed, and with all-transparent walls except for the senior directors' rooms and wash places? It needs the imagination of H. G. Wells, but housed in a more ruthless personality, to pursue the exigencies of functionalism in science applied to common needs, to their last relentless details.

We may feel this to be all wrong. Certainly the attitude of the artist who

makes things in the queerest and sometimes in the most irritating forms, just 'because he likes it that way', is an understandable reaction to functionalism. But this reaction is anarchical and, what is more serious, it provides no fundamental safeguard against the pressing claims of applied science for more and more power over our daily lives. Through applied science our daily experiences of creation are being squeezed out more and more by man's re-creation.

The nineteenth-century approach to the marriage between art and applied science, which results in harmonious design, was rather trivial. It can be illustrated by two examples. Ruskin's firm insistence on the divorce between the beautiful and useful can be illustrated from his sayings on 'vital beauty' (*Modern Painters*, 1843–60).

> The pleasure afforded by every organic form is in proportion to its appearance of healthy vital energy. . . . When we are told that the leaves of a plant are occupied in decomposing carbonic acid, and preparing oxygen for us, we begin to look upon it with some such indifference as upon a gasometer. It has become a machine; some of our sense of its happiness is gone; its emanation of inherent life is no longer pure. The bending trunk, waving to and fro in the wind above the waterfall, is beautiful because it is happy, though it is perfectly useless to us. The same trunk, hewn down, and thrown across the stream, has lost its beauty. It serves as a bridge—it has become useful; and its beauty is gone, or what it retains is purely typical, dependent on its lines and colours, not on its functions. Saw it into planks, and though now adapted to become permanently useful, its beauty is lost for ever, or to be regained only when decay and ruin shall have withdrawn it again from use, and left it to receive from the hand of nature the velvet moss and varied lichen, which may again suggest ideas of inherent happiness, and tint its mouldering sides with hues of life. . . . Whenever we dissect the animal frame, or conceive it as dissected, and substitute in our thoughts the neatness of mechanical contrivance for the pleasure of the animal; the moment we reduce enjoyment to ingenuity, and volition to leverage, that instant all sense of beauty ceases. . . .

Had Ruskin been content to say that artistic creation need have no concern with a useful purpose, this would be generally acceptable. But to place usefulness in direct contradiction of vital beauty is to impose stark functionalism on applied science and irretrievable escapism on art. In the more trivial matter of decoration, describing in approving terms the dresses worn by the wife of Canon Vesey of Barchester, Trollope says somewhat enigmatically, 'She knew the supreme art of decorating her constructions instead of constructing her decorations.' Quite where the bustle and the crinoline fit into this outline of dress æsthetics had not yet been established by antiquarian scholarship. But in our contemporary outlook the point surely is that the modern marriage of art and science cannot and must not be merely a trivial *rencontre*. Design must not be the outcome of a mere marriage of convenience, between the acceptable superficialities of art and inexorable minimum requirements of applied science.

Some of the main arguments for and against stark functionalism in applications of science are to be found in the history and functions of architecture, and civil engineering generally. Historically, a true marriage of motives is common. It is hard to fail to see the æsthetic purpose of many important Greek and Roman

constructions, even when these were based on applied science which was highly advanced at that time. Even in the modern fairyland of New York, with its amazing skyline, motives of prestige and advertisement that led to the building of such striking edifices as the Empire State Building are merely translations into modern commercial terms of perennial motives for fine building. Greek builders of the Parthenon may not have been motivated very differently in terms of ultimate human values. The civil engineers who built Stonehenge had discovered or inherited the science of moving and superposing heavy stones, but the use they made of this skill was inspired by purposes not derivable from applied science. It seems quite plausible to suppose that the circles of standing stones used in various impressive prehistoric ceremonials were artistic re-creations and stylizations of inspiring forest groves, whose trees are taller than man and in their life span so much less fugitive. Some people consider that the soaring pillars of the Gothic cathedrals, though they incorporate a much greater wealth of applied science, still reflect, as much as any artistic re-creation ever does reflect, the same basic experience of the kings of the forest. Of course, it is well known that any attempt to interpret the symbolism in art, however little transformed its re-creations may be, leads to a morass of debatable details if pushed too far. The reason is that, although an artistic urge must spring from communicable experience, the extent of its transformation before re-creation by the individual artist can involve inward stages difficult to substantiate objectively. Even professional psychologists are at times open to the accusation of somewhat arbitrary and fanciful interpretations.

Some degree of transformation of experience implies some degree of symbolic relationship in all artistic re-creation, for example in architecture. When the primary purpose of a building is non-utilitarian, as in a theatre or concert hall or church, it is nonsense even in our own time to exclude a strong artistic purpose; there are obvious functional purposes whose efficient satisfaction must also be assured. When the primary purpose is utilitarian, as in a department store, a bank, a library, a powerhouse, a factory, or even a mass dwelling house, the justification for insisting on a true marriage between applied science and art is less obvious. Yet such a marriage is just as necessary for a balanced civilization. Indeed, unless the balance of power is assured in such cases, the tendency to make such constructions what is termed 'purely functional' can become almost tyrannical.

In the most profound sense the reason for insisting on a seemly and proper marriage of art and science in all cases is that no work of man, and in particular no building, can evade its social influences. Every building constitutes a kind of social contract with the civilization into which it is born. It replaces by a man-made artefact the natural inheritance of skyline, light and horizon, wind and weather. This artefact in turn generates new experiences. There can be no question that the social aim should be to make such æsthetic experiences generally pleasing and elevating and enlarging, in so far as building is concerned. The power of controlling the play of light and shadow on the surface, the guidance of the eye by curves and lines and by directions, the sense of hurry and frustration

or of efficient living which the inside layout imposes on its users, the forming of pleasing patterns or dull trivialities in the space-time curves of individuals in a building, are not to be evaded by any servile flight into stark functionalism. Such a flight from the possibility of a marriage between art and science merely makes the choice one way.

With smaller artefacts, the element of social contract is usually less important in influencing design. However, at this level taste and fashion play a part which is so obvious that it need not be recapitulated here. For example, it is generally held that in the U.S.A. the design of automobiles must appeal to the womenfolk, quite apart from functional efficiency.

The conclusion drawn from the second section of this survey is that a true marriage between art and applied science is essential whenever the artefacts have a social influence. However, the form which this marriage should take and the extent to which art and applied science may influence one another legitimately needs working out afresh in each generation. To ensure their effective interplay, educational provisions need careful thought.

From what has been said, it should be clear that any aim to educate for real duality of creativeness cannot hope for success in art and pure science and is unlikely to succeed with many even in art and applied science. However, the applied scientist will not fulfil the social requirements of his constructions without some access to artistic creation. And the artist will miss much contemporary opportunity, unless he is given some access to applied science. These two requirements form the educational demands on a union between art and science.

At school, their satisfaction cannot be pushed very far. The important thing at all stages of education is to awaken and sustain interest, without which mere learning is deadening. It would lead too far to discuss the ages at which such interest is best aroused. Some hold that as soon as the child shows a creative interest in matter, the difference between his creations and really effective works of art should be made clear to him. On this view, some access to art would precede some access to applied science. However, such a view rests on special ideas about educational metabolism in the young, which are perhaps controversial and not suited for discussion here.

After leaving school, in higher education the needs of the scientist for access to art are easier to satisfy, than the needs of the artist for access to applied science. For the scientist, a degree of virtuosity seems to be the ideal. Only a man's own field of creativeness demands real depth of training. Charles II and his contemporaries showed a remarkable combination of artistic judgement and enlightened scientific curiosity. Though the fields of inquiry are much larger to-day than in the seventeenth century, that is no reason why a balanced approach to the creativeness of others should be more difficult to encourage now. In Britain the progress of a general interest in music during the last fifty years is well known. Given a similar tenacity of purpose, there seems to be no major reason why a corresponding growth of interest in other arts should lag behind.

The applied scientist whose creative work will involve a social purpose needs some access to art more profound than mere virtuosity, in the particular fields where a marriage of art and science has important social consequences. It is questionable whether provision for such access is at present adequate. A survey of what is being done in various programmes of higher education might show up some grave insufficiencies, and would help to focus the consequent harm to the balance of civilization in the next generation. Tenacious pursuit of a reasonable programme of access is the only remedy, since the main difficulty is want of attention to this need.

Educational access of the artist to science is in many ways more difficult to ensure. Like every other civilized being, the artist needs some access to the generality of modern scientific procedures and scientific results. Like most non-scientists, for this he must depend on adequate and authoritative works of popularization. Ways to facilitate access by non-scientists to the chief methods and results of science are of quite general importance for the balance of civilization. The difficulty is to arouse and sustain interest without sacrificing scientific integrity, and without pontification on the part of the scientist. However, this is a general educational problem, and its details do not concern this lecture.

In addition to needing access to the broad generalities of science, future creative workers in various branches of art need profound instruction in what may be called the properties of materials. Applied science has an obvious job to do, in providing facts about the properties of materials as foundations for the arts. Traditionally, one of the first things a painter's apprentice learned was how to grind colours and prepare surfaces. Nowadays this is in part left to commercial production, with a saving of time but some loss of that intimacy with matter which a creative artist must maintain. With traditional materials, the heritage of experience can perhaps make up for the modern, less intimate approach to the matter upon which an artistic purpose is to be imposed. But such excuses cannot apply to the materials with no past artistic history, that have become available within the last thirty years. There are new metals, new plastics with various fillers and reinforcements, synthetic stone and concrete, new pigments, new textile fibres, new means of carving and cutting substances far harder and more durable than perishable man. These new materials are being applied on a rapidly increasing scale, as soon as it becomes economic and profitable to do so, in accordance with technological opportunism. But the opportunities they also present for new artistic experience are only just being nibbled at. A course of instruction that combines the detailed information of the modern technical salesman of new materials, and the integrity and leadership of creative artists, is needed to familiarize future creative artists with the material possibilities of modern technology. Only a systematic survey will direct the artist's choice to new materials, awaiting the imposition of a new artistic purpose. It is in the new forms of matter and in the new ways of handling matter that modern applied science and modern art can find common ground for a true marriage, and for maintaining the balance of civilization. Like the applied

scientist, the artist should be untiring in searching out new possibilities in subjecting matter to a human purpose.

DISCUSSION

MAJOR W. V. G. FUGE, M.B.E.: May I ask the lecturer whether any artist has designed an artistic power station?

THE LECTURER: I do not know that an artist who did not have much else to him or who did not collaborate with other people expert in applied science, could design a power station. If you want me to say whether I know of any satisfying power stations—well, I have a sneaking liking for a grey day and scudding clouds and the smoke coming out of places like Battersea Power Station; but I have heard applied scientists to say that its walls are just sham and that in Tektopia they would not do, things like this. They would just have the tanks and tubes up and nothing to hide them; and it is very difficult, unless you have a real grip on this problem, to say anything against such an opinion, because it costs much more to produce even Battersea than it does to put up the tanks and tubes.

MR. HARRY ROSENTHAL: In the Tennessee Valley Scheme (although it was not created by one man) there are plenty of power stations and I think they blend perfectly with the whole scheme, which to my mind is one of the magnificent examples of the marriage of applied science and art.

MR. M. F. CARROLL: As an applied scientist I think I can speak for my colleagues who deplore the failure of artists to get to know more about what we are trying to do and as the converse of this, I would ask the lecturer to tell us what The Imperial College is doing to enable a rather homogeneous collection of scientists to become acquainted with the Arts?

THE LECTURER: Apart from quoting St. Paul about the leaven in the lump, it is difficult for me to reply cogently to that question! We are well aware of the educational difficulties. Lumps tend to be very lumpish and it is difficult to get the leaven working. This difficulty is not restricted to my own particular institution: there are very many other places where it exists, some of them, perhaps, less conscious of it. Perhaps the Chairman would like to comment?

THE CHAIRMAN: I can only add that, as a beginning, Professor Ubbelohde and I are promoting a dining club to cement the marriage between the artists of the Royal College of Art and the scientists of the Imperial College.

MR. F. J. W. HARDING: Professor Ubbelohde said that the artist should get to know something about the new materials. I wonder whether he thinks that it might be possible, in some cases, for the artist to go a little beyond that and find out something about the methods by which the materials are produced, and the scientific principles involved? I am thinking really of Leonardo da Vinci. His example makes me wonder whether an artist, or manufacturer, should know something about, say, the laws of thermodynamics, or whether that would be too much to expect.

THE LECTURER: I would say that everybody ought to know a little about thermodynamics, but I think that one should progress from the most readily assimilated to the less readily assimilated scientific principles, and I am quite sure that there are things of more immediate importance than the laws of thermodynamics that could be digested with the help of, for example, the big industries producing new materials, who are probably very keen to arouse this kind of interest in their products. I certainly think that knowledge of production methods as well as of properties is valuable

and useful. It must not take too long to absorb, if we remember the old saying that art is long and life is short. Life will get even shorter unless we organize this kind of marriage very intelligently.

MR. R. W. HOARE, A.R.I.B.A.: If I, as an architect, may return to the subject of buildings, which are akin to the field of civil engineering—I should like to say that we do humbly try to achieve this marriage of art and science. Architecture, as the mistress art is, I feel, the branch of art which is nearest to science, and certainly, in these days, to applied science. I believe the lecturer used the term 'boot-boxes'. Well, we all know such things exist, and they are tending to spread; but to a large extent buildings are controlled by economics, and a building which is purely functional has at least that merit.

With power stations I feel the situation is better. Architects design lots of buildings of all kinds for industry, and in this field we are very closely allied to the engineers. It should be possible to produce power stations which are functional from the points of view of applied science and beautiful to look at. Perhaps in the course of the next few years we may see this marriage celebrated in the new power stations.

THE LECTURER: I agree with much of what Mr. Hoare has said. He is quite right in saying that economics are the controlling factor in providing boot-boxes. But the point we must make is that such economics are fallacious and, in the long term, harmful. We are losing much by these apparent economies. This is part of the risk of over-emphasizing functionalism. It may well be that mere functionalism is cheaper in the short term if you neglect all the imponderables that mount up so accusingly in the long term. But the object produced ought to be as satisfying as it is functional. I could argue, for example, that thousands of city workers walk up Ludgate Hill every day for years during the life of a set of buildings, and that the response of these people either to this 'boot-box' or that properly arranged marriage is worth a great deal, even economically. One must not accept boot-box economics, but one must present a well-founded reason for departing from them. One must formulate clearly the real reasons for insisting upon a proper marriage; it is no use relying on pious hopes, because accountants always defeat pious hopes.

BRIGADIER J. L. P. MACNAIR: I understand that Professor Ubbelohde feels the real point of marriage between science and art is the conjunction of applied science and presumably of direct or applied art. But I think one can go further than that. When you come to consider abstract science and, as a corrollary, abstract art as understood to-day, there is a link, because the more abstract the scientist becomes the more rarefied the atmosphere in which he lives. To pursue abstract science in the way it must be pursued by brains like Professor Ubbelohde's, it is necessary to have not only logical and mechanical powers of reasoning but imagination as well. You have got to be able to lead from one idea to the next even though the next does not necessarily seem to follow immediately. The really first-class scientist starts from an idea, and by using his imagination he works backwards to find the connecting link. That is art.

Now when one turns to the artist one is sometimes inclined to shudder, because so much of abstract art as we see it to-day is almost too easy. One of the best manifestations of abstract art I have ever seen was produced by my grandson, Mark, aged 7—a beautiful picture, all in all. I speak not in a derogatory sense: he can produce it and so can a lot of other people. No artist should be allowed to produce abstract art until he has taken an apprenticeship in art, the hard way; including, amongst other things, a power of draughtsmanship which appears to be wholly lacking in many present-day aspirants. This kind of power corresponds to the logic of science.

On a more concrete base, I do not know whether we should be justified in asking Professor Ubbelohde what he thinks about the design of the new Imperial College of

Science in Kensington. I was horrified to see a few days ago in *The Times* a design which consisted of a collection of what Professor Ubbelohde calls 'boot-boxes' stuck down in irregular positions, lacking any sense of symmetry, devoid of character, and all straight lines (except for something suggestive of the Festival Hall in one corner of the campus). It is a rather terrifying prospect.

THE LECTURER: If I may reply to just one of Brigadier Macnair's observations—this question of the possible parallels between abstract art and the abstractions of pure science. Although the importance of the imagination as a human starting point cannot be denied, so far as I know the connecting processes of pure science are mathematical, and therefore logical; and also, so far as I know, the processes of abstract art have nothing whatever to do with logic, though they may achieve forms of an order higher as well as lower than those in logic.

THE CHAIRMAN: This has been one of the most interesting lectures I have ever heard in this hall. Obviously it was very condensed and a great deal of the thought which has gone into it could be expanded. I thought myself that the most interesting idea Professor Ubbelohde advanced was the mutual repellence between functionalism and abstraction. This he postulated, and I think it is debatable. But if it is true, then I do not think that there ought to be too close a marriage between art and science, because a degree of abstraction has always been very important to the arts and functionalism has been no less essential to every form of applied science—so I think we must have a marriage with frequent holidays.

I propose a warm vote of thanks to Professor Ubbelohde for his brilliant lecture.

The vote of thanks to the Lecturer was carried with acclamation, and the meeting then ended.

THE ARCHITECTURE OF NEW TOWNS

The Alfred Bossom Lecture by

FREDERICK GIBBERD, C.B.E., F.R.I.B.A., M.T.P.I., F.I.L.A.,

delivered to the Society on Wednesday, 22nd January, 1958,
with Sir Alfred Bossom, Bt., LL.D., F.R.I.B.A., J.P., M.P.,
in the Chair

THE CHAIRMAN: I do not believe that many people in this room will have heard the subject before us treated in such detail as it will be by Mr. Gibberd this afternoon. Looking back over world architectural history, we find that it has not been the custom to build entire towns, except under emergency conditions such as those existent during the war. The old walled towns of France and England provide a few examples, not many, but these were not completed in one operation. On the present occasion we have a story of people making an entirely new scheme of development and we are going to be told of the problems that have had to be faced, of serious situations that were not easy to overcome. And we are also going to learn that we in Great Britain are doing something that has seldom been done in any other country in the world under normal circumstances.

The following lecture, which was illustrated by lantern slides, was then delivered:*

THE LECTURE

When I told a friend of mine I had been invited to give this lecture, he said 'Jolly good: you can go to great heights; and then jump down on the face of X', naming a critic of the new towns.

It is curious, is it not, that we in this country are so diffident about our achievements? Hundreds, no, thousands of foreigners visit our new towns; they are astonished at what they see. There is tremendous interest abroad. And yet we, who are succeeding with one of the biggest social problems the world has ever attempted, are almost completely indifferent.

There is, of course, some confusion between the word 'new' and novelty. Because the towns are new many people are disappointed that they are not novel, as if there were something meritorious about novelty. One of the many architects who visited Harlow to tell us how we should have done it complained that it did not excite him, as did the new Citroen motor car. We did not set out to be novel but to produce a new town—a town where people could live, work and play together with the greatest possible freedom and dignity.

The subject of this lecture is a vast one, and so I will narrow it down to the English new towns and in particular the one I have experience of, Harlow. I am supposed to be talking to you about architecture, but I cannot do this

* Some sixty slides were shown in the course of the lecture, which has been revised to accord with the very much smaller number of illustrations which can be accommodated in the *Journal*.

without also talking about the land on which the buildings are put and the roads which connect them together.

In town design the three arts, or sciences if you wish, of architecture, landscape architecture and road architecture interact. The first stage in bringing them together into one unified design is, as you all know, the town planning technique of preparing a Master Plan. The plan is preceded by a survey of what is needed and what is there already. It is never more than a broad and flexible master design and is followed by a series of detailed development plans of each area. The resultant design is, therefore, evolved through development, modification and change. It is an organic process: and one in which more and more designers are brought into its orbit as it develops. It is a quite new technique, entirely different from the design of historical new towns, where one designer laid down a complete and final crystalline pattern; just as to-day you find architects designing ideal town types which, however amusing they may be as expressions of egocentricity, are remote from reality.

The broad pattern that has been evolved for the British new towns is based on our way of urban life; a way which, amongst other things, prefers segregation of home and work, which enjoys open-air exercise, which has an innate love of

FIGURE 1. *Harlow New Town: aerial view: Mark Hall North and South. South-Eastern Industrial Estate in far distance*

nature; which makes use of motor transport and which, although demanding privacy for the individual family, likes some measure of community life.

The plan is a nucleated one. It defines distinct areas for home, work and play; it sketches out a social structure in the form of neighbourhoods, schools and shopping centres; it lays down a pattern of open space and landscape connected to an agricultural belt; and it defines a system of road circulation, free of building.

Industry is planned adjacent to the railway and always within easy reach of the regional roads; housing is arranged as distinct neighbourhoods with their own shopping and social services, and the town centre with its business, entertainment and civic groups, is placed as a focus of the design.

It is apparent (Figure 1) that one building type, housing, covers a very large area of the plan. This is because the majority of the people want a two-storey house with a private garden and this is the cheapest form of dwelling. I will deal with this problem later. At the moment I wish only to make the point that, since housing does cover so much land, there are advantages in some mixing of building types.

'Use zoning' is necessary to prevent the evils of the unplanned town, but it can lead to dullness through uniformity of building type if too rigidly applied.

The neighbourhoods of new towns are not as dreary as L.C.C. and other vast estates but there might, for instance, have been more intimate relationship between buildings like schools and houses. Shopping centres might have been in closer contact with housing and there might have been more link with industry.

In the Harlow plan there are two main industrial estates in the north and five other areas of service or light industry; thus, industrial architecture contributes to the general scenes of the town and it provides contrast to domestic architecture.

On the other hand, at Stevenage there is one large estate which, although splendid in itself, tends to be aloof and might become a place where you go to make money for the privilege of living in the rest of the town.

The building groups are superimposed on the landscape; which is in itself a positive design.

One of the great problems in the design of large areas of new building is to obtain variety; unity is comparatively simple. We need, therefore, to make the maximum possible use of existing character, *genus locii*. As it is, all the new town plans are based on the exploitation of the existing topography, and there is no doubt that it has given them individuality.

Miss Sylvia Crowe[1] illustrates the point in a comparison between the design of Harlow and Basildon:

> The plan for Harlow shows it broken up into compact and separated neighbourhoods, grouped round the central massif of the town centre, which, sited on the highest ground, will provide the skyline with a fine silhouette of buildings. The pattern relates intimately to the existing landscape of scattered woods, low hills and intersecting valleys. On the site of the new town of Basildon, the landform suggests no such definite division between the neighbourhoods, which lie more closely together round the rim of the shallow saucer of low-lying ground which will form the town park. . . . In each case the plan echoes the general character of the landform and neither could conceivably have been evolved on the other site.

FIGURE 2. *Harlow New Town: landscape wedge, Mark Hall North, with sculpture by Henry Moore and buildings by Frederick Gibberd*

The existing topography can give the town individuality, and the landscape design itself will provide variety through the contrast it can give with the buildings—natural forms against geometric. Instead, therefore, of a thin straggle of landscape and building, we need broad landscape belts sharply contrasted with compact building groups—this is Mark Hall, Harlow (Figure 2). The pity is that the building groups were not higher.

As yet all we can see in the new towns is the preserved landscape, but each one of them has a positive landscape design which is being carried out on a scale not attempted before in this country—at Harlow we have planted over sixty thousand forest tree seedlings; forest trees, not just ornamental trees and shrubs. In years to come it will be evident that there has been a revival of the splendid English landscape tradition, one of our major contributions to the world's art.

Running in the landscape between the built-up areas are the main town roads, linking up the various parts of the town to each other and to the regional road pattern. These roads are designed for motor traffic: that is, they do not provide building frontage; they take smooth and flowing curves; there is a minimum number of intersections; there are no cross roads; and no traffic lights. That only one of the dual carriageways has been built is due to the Government, who will not allow us to do the job properly.

The secondary road system is subservient to the building group, its source

FIGURE 3. *Harlow New Town: 'The Lawn'. The nine-storey flat block related to a three-storey block and two-storey terrace housing. (Architect: Frederick Gibberd)*

being a group of dwellings. The system is an organic one, like a river. As the traffic builds up in volume so the road gets wider and smoother in its flow.

Mr. Colin Boyne complained in a broadcast[2] that you drove through a new town in absolute safety between the neighbourhoods and then, when you thought you really must come to the town centre, you were out in the countryside again. This, of course, is exactly what the main town roads are designed to do: to take you smoothly and swiftly about the town. That you do not see a town centre is simply because no development corporation was foolish enough to embark on one until there was sufficient population to support it—it is people, not buildings, that make a centre.

The main roads have very great architectural significance. They are significant as road architecture—things which are seen; and they are significant as moving viewpoints of architecture—from them you see a rapid series of pictures of the town. As road architecture the problem is one of fusing road engineering with landscape design—problems of cut and fill, cross fall and so on. As viewing points the problem is to relate the line of the carriageway to bold architectural and landscape compositions such as a large secondary school, or a wood.

Figure 3 shows one of the eleven tower blocks at Harlow, all of which have significance in the road design.

The design of the main roads is of bold sweeps and broad masses but the other system of circulation, cycle tracks and footpaths, is intimate and small in detail, to be seen at comparative leisure. The cycle track takes the shortest possible distance between the various centres. That is, it passes through the built-up areas and, wherever possible, it makes use of existing lanes and trees. When the track crosses a main traffic stream an underpass is provided—generally on the drawing board!

We cycle on these tracks, or we race along the main town roads, to arrive at the town centre.

We have arrived at the town centre because it is the focus of the traffic system. It is also the focus of the town community life, of its business and of its administration. Into its orbit will be drawn as many different activities as possible, like the sports stadium, the town park and service industry, because by so doing it will always have some life and bustle.

We leave the main town road and enter the centre itself, where we are at once confronted with a belt of car parks and an inner periphery road connecting up to other car parks. You can see the parking belt in the foreground with the connecting road and the dense centre beyond. And here we are inside the park, with a view of the tower that marks the eastern entrance to the centre. From the parking belt there are short cuts leading to the inner core, which is exclusively pedestrian.

At least, we should be able to do all this: unfortunately not all the new towns have adopted the pattern I am describing. At Hemel Hempstead and Crawley, and Corby, for example, the shopping street is also a traffic street and there are bound to be conflicts between the two.

The approach to the town centre is entirely different from the old town,

Crawley Development Corporation

FIGURE 4. *Crawley New Town: 'Broadwalk'. First stage of Town Centre Development. Pedestrian shopping way linking existing shopping centre in Crawley High Street with New Town Centre to the east. (Architect: H. S. Howgrave-Graham)*

where building gets denser and denser and roads narrower and narrower. Building stops, there is a broad gap and then there is the dense town centre itself, looking rather like a medieval town surrounded by a moat or fortifications and, incidentally, about the same size.

In the pedestrian core we can once again enjoy the pleasures of an urban environment. Figure 4 is Crawley, by Sheppard Fidler and Howgrave-Graham. We can wander from shopfront to shopfront, window shopping; see architecture as it was designed to be seen; sit in a pavement café and watch the busy scene; or just sit. The comparison with old towns, where urban squares are either car parks or roundabouts and shopping streets are jammed with traffic, is remarkable. With the exclusion of the road it is possible to form a series of urban spaces, each with its own character and each designed as a place to be in. The spaces can flow into each other, or there can be abrupt changes between them, depending on the function of the space and the character desired. The buildings are no longer just architecture, they are the means by which we form spaces for urban living.

An example of this theory in practice can be seen at Harlow town centre. A typical sequence of spaces is from the principal shopping street, through the Market Square, and down a narrow shopping precinct to the car parks. The spatial contrast is between a long, wide shopping street, a large rectangular Market Square and a small, narrow street.

The shopping street is long and wide to encourage large numbers of people to parade up and down and to cross easily from shopfront to shopfront. The

FIGURE 5. *Harlow New Town: view into the north-west corner of the Market Square, with the office block on the right and the two-storey shopping terrace on the left. (Architect-planner: Frederick Gibberd; executive architect: Victor Hamnett)*

view in one direction is closed by the Market Square, and the other will be closed by the civic buildings. Deep canopies separate the shopping display from the architectural composition above. There are two kinds of view in a shopping street: the lively shopping parade, seen at eye level, and the general architectural composition seen when you view the street as a whole. The canopy or a recessed front prevents the two from becoming confused.

In the Market Square itself (Figure 5) the functional requirement was a large space on which to set up the market stalls. The buildings are large, to be in scale with the space, and since marketing should be a gay and lively activity the buildings are gay and lively—the architectural expression is influenced by the scale and character. The change from the Market Square to the narrow street is marked by a change in level, there being a flight of steps and a ramp. The narrow street itself has continuous shop windows and the opposite façades are close together, the resultant space being a long and narrow one.

Spatial design of this nature is extremely difficult because you have to reconcile two kinds of space; the internal spaces of the building are the external spaces of the townscape. The buildings themselves must have ideal conditions for their function but at the same time their external façades and their masses must provide ideal town spaces. It is a difficult process but it is the very guts of town design, and it is certainly one of the big contributions the new towns are making to architectural design.

I mentioned a change in level between one space and another. A new town gives the possibility of developing spatial sequence at different levels. Thus, parallel to the normal market scene, there is a first floor sequence. The opportunity arose through the need to provide continuity of shopping at ground level, with the need to have buildings other than shops on the Market Square and its approach street. But I really designed it just to give pleasure.

The same broad, functional system occurs at Stevenage, but the design is entirely different. Here the pedestrian space pattern is a long, north to south shopping precinct, with two streets entering it at right angles on one side and a town square centrally placed on the other. The street is staggered so that the views are closed down it, and the three storey buildings are higher than the space between them: this, together with the 3 ft. 4 in. module upon which the whole design is based, will make a very urban and architectural environment.

In the Square itself (Figure 6) the trees are existing and they are very beautiful; the space is furnished with a clock tower and sculpture and is bound to be busy, as the 'bus station is adjacent. Although this centre is not yet open, it looks stunning and will be one of the most interesting in Europe.

The civic and community buildings at Stevenage are on the perimeter roads, and I personally would have drawn them into the space pattern, as Noel Tweddell has at Basildon, where his Town Hall dominates one end of a central square.

It is when we come to consider the architectural qualities of the housing that the new towns disappoint us. We must accept that they are inferior to the best eighteenth- and nineteenth-century town building. No new town has the quality of Bath. This is nothing whatever to do with the capabilities of architects—the

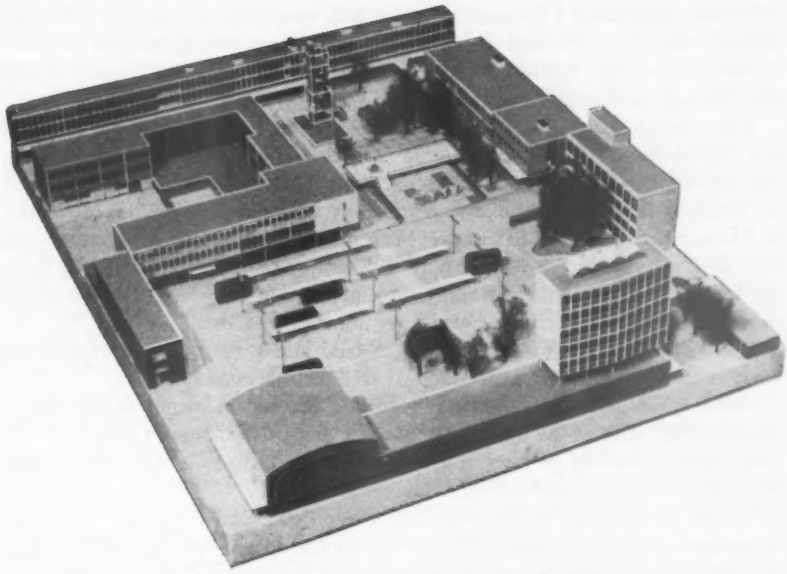

FIGURE 6. *Model of Stevenage Central Square. (Chief architect: Leonard G. Vincent)*

Woods were great architects, but given the same conditions Powell and Moya could be as great. The reason is, quite simply, social revolution. Unlike the Woods, we are not building for one social class consisting of large families with several people looking after them, we are building for all classes, for small families and for an individual dwelling for each family. The over-riding desire is for a two-storey house with a private garden, and it is mainly responsible for the large area the town covers. Even when it is built reasonably compactly, as in this area at Harlow, it is a village scale, not a town scale. If, in the new towns, a house had been placed over a house (four-storey maisonettes), the area covered by the housing would have been halved and the visual scale doubled. It is as simple as that.

Whether you like the social state or not, you should not blame architects for its expression.

Mr. Furneaux Jordan, in an article damning the new towns[3], suggested that a correct æsthetic and architectural solution would, in the end, have proved a correct social one. In other words, you scrap the town planning and social survey and give people what you think they ought to want. What fun it would have been to surround the town centre with a dozen or so tower blocks like Vallingby, the new Stockholm satellite. But perhaps it is more important to encourage the development of the human personality and the English way of life. You start this process by giving people more freedom, not less.

On the other hand, I believe that the towns, when they are socially balanced, can take from twenty to thirty per cent flats without restricting personal freedom. If they did so, they would gain immeasurably as towns and the country would gain through saving precious land.

There would, of course, be difficulties. For example, the Ministry of Housing and Local Government is suffering from a mild case of schizophrenia. Dr. Jekyll's department issues Housing Manuals showing us how to save land by building maisonettes, three-storey houses and flats; but follow his advice and hear what Mr. Hyde has to say: 'You must be mad going over two storeys with land at only £100 an acre. Why, at Crawley they are only building three per cent flats.' There's the rub: only three per cent at Crawley. The new towns have very different policies but we all get branded with the same iron.

The increase in height gives saving in land and a more compact town, but what interests us here is that it has great architectural consequences.

There is far more to it than just getting a contrast in height to two-storey development. One of the most naïve of the many naïve designs I have seen for ideal towns consisted of rows of Le Corbusier's Vertical Garden Cities rising from an undergrowth of detached bungalows.

No, the importance of the extra floors is on the spatial pattern. There are countless squares and closes in the new towns that look empty and characterless because the buildings are out of proportion to the space. If, for example, you have a close 100 ft. square and the buildings round it are of two storeys—18 ft.—they will be so out of proportion with the width between them that the effect is of an open space with buildings ranged round the edge: in a close this size the buildings need to be of at least four storeys to give any architectural and spatial significance.

When the percentage of flats is rationed, you need to exercise considerable cunning to make the most of them. Thus, fifty flats will make far more visual impression if they are used sparingly and in combination with houses—a flat over a house to give three floors; a maisonette over a house to give four floors—rather than in one single block.

Apart from the lack of height, monotony arises from two other causes: sameness of architectural design and too wide a space pattern. Unlike the old town, there is no variety through areas of different historical style or different social class. Where a development corporation has insisted on its own architectural department doing the majority of the housing, the result tends to be dull, simply because one office is bound to repeat itself in so large an enterprise.

The solution was, of course, to obtain variety through change in architectural design. This is quite simply done by breaking down the neighbourhood into a series of housing groups (say two hundred to four hundred dwellings), giving each one to a different architect and, having done so, encouraging him to be himself.

We tried this at Harlow, where twenty-five different firms have been employed; and we extended it in our own office by forming different design teams for each job. Architects, like other artists, tend to be egocentric, and there have been

times when Victor Hamnett, the Executive Architect, looked extremely distracted. But he would agree that it has been worth it. Certainly when walking through a neighbourhood from Cadbury Brown to Richard Sheppard to F. R. S. Yorke (to take one sequence), one is very conscious of moving through distinctly different places.

Incidentally, this change in architectural character also helps the social structure, as it gives a sense of neighbourliness on a smaller scale than the neighbourhood proper. We have underlined this by providing tenants' common rooms.

The Development Corporation are not responsible for all the housing, and there has been a sad levelling down of architectural character by local authorities and speculative builders producing dull and timid schemes. On top of this, we have all suffered through being required to build fifteen per cent of proprietary houses of a construction alternative to brick.

'Non-trads' (what a hideous expression), look more traditional than the traditional house. I suppose it is because they are designed to appeal to the taste of the average housing committee. Some of them, such as the Wimpey 'No-Fines', give some flexibility to the architect—Lionel Brett has done some charming terraces—but on the whole they lead to monotony because, occurring at intervals over the whole town, they dilute changes in architectural character.

So much for sameness and monotony of design. What truth is there in the accusation that the space pattern is too wide? Driving round the new towns we have to admit that there is a general impression of openness and draughtiness; that they are in the tradition of the Garden City movement which brought in the garden but threw out the city. The spine roads through the estates are nearly always too wide—70 ft. is common, which looks vast between buildings 20 ft. high; the spaces at road junctions are excessive; there are too many gaps in the building development and there are far too many odd spaces and corners. All this tends to produce a rather nondescript mixture of space and building, with little urban quality and no contrast to the landscape pattern.

I appreciate that there have often been reactionary bye-laws. How sad it is hat the Government, in deciding to build new towns, did not free them from the restrictions made for old ones. Nevertheless, there are very many cases where there could have been a much closer development.

The first neighbourhood at Harlow, Mark Hall North, illustrates our basic design principles. There are three housing areas, each by a different architect. The areas are reasonably compact and they are contained and contrasted by landscape design. The dwellings are fitted into the topography in such a way that they reflect the form of the land. The buildings are grouped to form a series of streets, squares and closes in which the road is of secondary importance. The architect began with the design of the housing group and developed the road pattern from it.

The housing itself is mixed development. This is not just the introduction of a few corner flats into a two-storey housing scheme, but using all kinds of dwellings to produce a series of visual pictures with variety in each and unity

over the whole. Figure 3 shows a tall flat block related to three-and two-storey development.

The fault that architects find with this first neighbourhood is that it is too open and loose.

The next illustration (Figure 7) is of Orchard Croft, a later area at Harlow, where the buildings are knitted much closer together and the space pattern is more strongly articulated. The density of population has been almost doubled—from about thirty-six to sixty-five people to the acre.

The terrace is used in an almost continuous form with the minimum number of gaps; when an internal corner is reached it is turned by a larger house and the external corner is formed by flats. This means a great deal of work for the architect as, instead of drawing a few type plans, he must produce long strip drawings of the whole of the street or square to a large scale; but it results in the eye being contained by the buildings, and the spaces have the maximum significance.

The layout illustrates a particular theory of mine about housing, that there are really only two kinds of space: the space behind the house, which is the private garden; and the space in front, which is the communal street picture. The aim in design is to separate these two different types of space by continuous façades or by screen walls, so that you shut in the private garden in the rear and have a series of architectural street pictures in front.

FIGURE 7. *Harlow New Town: Mark Hall and Netteswell Neighbourhood, looking south over Mark Hall South with Orchard Croft in the foreground*

It is important that no private gardens are allowed in front of the house, so that the floor of the space extends between opposite façades. When this is paved we begin to get an architectural, towny environment—unfortunately grass seed is so much cheaper. However, you can cut out the grass verge, and a simple stretch of lawn will give a reasonable street picture, if only because the ground plane is not disrupted and cluttered up with nasty little walls and fences, to say nothing of the horrors of bedding out.

By now prices have risen and my Corporation have amassed quite a few restrictions on design—they dislike maisonettes, flat roofs and felt roofs are 'out', and so on. It is more and more difficult to light the flame of originality; only the dim and smoky glow of the commonplace is readily accepted.

Our most recent scheme is based on the two-storey house with private rear garden. The pattern is a cellular one; that is, it consists of a regular series of squares or closes in which the buildings are grouped round a paved area with no through traffic. Each close is designed to be of a different character, and each one has a three-storey block down one side and individual three-storey houses at focal points. The three-storey blocks form a regular pattern over the general level of development; and the views are always closed by building development. The roads that link the closes together are as narrow as possible, but the spine roads, which had to be wide, really needed four or five storey development on them.

By now the demand for garages has risen to at least fifty per cent. An ingenious solution to their siting has been devised by Noel Tweddell of Basildon. It is a modification of the American Radburn layout. The houses are grouped around a rear service yard on which is sited the garage and from which there is access to the private gardens. The front spaces, being free from all services, can be composed about footpaths, into a series of architectural compositions.

Would that I had time to show you some of the very many other interesting schemes, such as Geoffrey Jellicoe's two-storey terrace at Hemel Hempstead, where he produces a castellated sky-line through putting on an extra floor at regular intervals. But this is really a subject for a whole lecture series.

The new town neighbourhood centres, with their shops, churches and other community buildings, form a series of dominant groups throughout the master design, on a secondary key to the town centre. My own particular theory was that, in a large town, you would have more vital, urbane centres if there were a few major ones serving groups of neighbourhoods.

The Stow was the first of these (serving seventeen thousand people), and there is no doubt that its fifty-odd shops and other buildings make a towny scene which is appreciated by the inhabitants. Its fault is that cars are allowed through it—one of my early defeats with my Development Corporation; but perhaps it is better to build with some faults than keep the drawings in a plan chest.

Groups of subsidiary centres of five shops or so are required in the neighbourhood for day-to-day needs. The group by Lionel Brett at Hatfield (Figure 8) is one of the most charming. The shops are related to the Hall by areas

of beautifully detailed paving and screen walls; the sculpture provides a pivot for the composition.

There are, of course, all kinds of centres in the new towns. Some of the larger ones have been planned round squares or greens, and one is round a car park. The open types have been criticized as being draughty; certainly they are quite contrary to their traditional equivalent, the small town, narrow, intimate and varied shopping street.

In the vicinity of any shopping centre you will always find all kinds of small firms and odd characters making and mending; engaged in what planners call

[*Architects' Journa*

FIGURE 8. *Hatfield New Town: Roe Green Neighbourhood Centre. (Architects: Lionel Brett, Kenneth Boyd, Peter Bosanquet)*

service industry. People like the glazier, jobbing printer, cabinet maker, are very valuable members of the community; but they can afford little rent and usually make do in old residential property, or sheds in derelict back gardens. The rents of the industrial estate were quite beyond them, and in any case they would be quite out of place in such an environment. The solution to this problem was found in the provision of planned areas of service industry, associated with major shopping centres. They are then tucked away out of the general urban picture. The backs of the shops generally provided a screen on one side, and

buildings that could have any architectural character, such as a Service Station, were placed on the other.

I know I am now talking about planning, but it has important architectural consequences. The service industrial area provided a rag bag for all kinds of small sheds, buildings and yards. It contained them within an ordered framework and drew them off from the larger scale shopping scene—there was less fear of the centre tailing off in interest, as so often happens in the unplanned town.

Many of the buildings in the neighbourhood and elsewhere are by agencies other than the Development Corporation. They give a chance to obtain variety from housing, but, alas, they have been, on the whole, disappointing.

I know the English are indifferent to architecture: nevertheless you would think that a building promoter would be excited by the idea of building in a quite new environment and would take some trouble about choosing his architect. But all too often it has been the same unimaginative or downright dull stuff that is put up everywhere. One architect even asked me to approve three alternative front elevations for a block of shops because he liked to give his client a choice; the noble art reduced to the level of millinery.

I know there have been one or two good churches and pubs; that the County Architects and the Ministry of Works have produced a whole series of distinguished buildings; I know that there are few really bad buildings; but on the whole the scene is let down at just those places where a building of vitality and contrast is needed. The pity is there are so many brilliant young architects, if only promoters will trouble to find them.

Let us return to the ancient or medieval new town plan, for that is the pattern of the industrial estate.

The modern factory is a giant, flat, rectangular box. Its ideal site is, therefore, a dead flat one, and the most economical way of relating factories to each other is in a parallel series. Unlike the housing group, the layout of the main industrial estate will be rigid, uncompromising, geometrical.

The only difference from the Greek, Roman or medieval gridiron is that, due to the motor car, the T-junction will have superseded the cross road.

Since the road widths bear relationship to the volume of traffic on them, a large site can best be developed by first setting down a main spine road. The site may then be developed in depth by setting up a series of super blocks off the main spine road. The prototype for this pattern, in so far as I am concerned, is Sir William Holford's layout for the Team Valley Estate.

The office blocks screen the production areas to give a tidy street picture, and in the heart of the plan is an area which is used for expansion—we thought this might be used for lunch-time recreation but, due to the facilities that a planned town provides, there was no demand.

The internal views are often untidy and lively. The external views are quieter, tidier and more in the nature of street pictures.

You will appreciate that a scene like this is an architectural street picture. There is no grouping to form spatial enclosure, as in other parts of the town.

No space for congregating is needed, since the whole life of the estate takes place under cover. There are only the functional spaces for roads, for the parking of cars and for the expansion of buildings.

The larger factories will be placed on the main spine roads and special sites will be given to special buildings.

I have no time to review the many interesting industrial buildings that have been evolved; there really are some splendid designs, and there is a refreshing absence of that by-pass eye catcher, the central tower feature housing the tanks. But I must say this: in the new towns you will find industrial estates that are a pleasure to look at and a pleasure to work in; they make a splendid contribution to town design and they are without equal anywhere.

I have only talked about very general and very broad issues. Perhaps you are disappointed that I have not talked more about architecture, about patterns of fenestration, about those clichés that will get you published in the architectural glossies—and those that won't. But to me architectural style is a transitory and unimportant thing compared to the design of the human environment.

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DISCUSSION

THE CHAIRMAN: I believe you will all agree that we have had a very unusual and most interesting survey of how our new towns are being created. It is not a problem that the average architect was trained for when he was young. We all know the old-fashioned village, the old-fashioned town, but these under review are new towns, in the main, planned from beginning to end substantially by one mind. Other minds have been concerned with the details, and in this more with the way they are carried out. Some years ago, when the London County Council was developing new districts such as the one near Blackheath, they did very well. But that achievement could not be compared with the type of layout, building, environment and completeness which these new towns are providing for people to spend their whole lives in. Mr. Gibberd has completed a great task and everybody present, I am sure, would agree with me in sincerely congratulating him.

Now, may I ask a question? How long did it take you to conceive and formulate your master plans?

THE LECTURER: I spent a long time, about two months to begin with, just wandering round the site. Altogether I think the first sketch master plan of any consequence took about six months to produce. I did not make it: it was done by the Ministry of Town and Country Planning, the Ministry of Agriculture, the County Council and all kinds of other people; it was done by the character of the site itself. All I did was listen to these people; get them to help me; get to know the existing character; and in this way the plan developed.

MR. A. F. RUSSELL: Mr. Gibberd said that one of the reasons for his lecture was that he believed there was still time for improvements to be made in the New Town Development which had still to be carried out.

What improvements and changes in design would Mr. Gibberd like to see incorporated into the shopping centres and housing areas still to be executed?

THE LECTURER: What a difficult question! I would do all I could to take traffic out of the core of town centres—turn shopping streets into pedestrian precincts.

I would strive for the appointment of really good architects. I am convinced that on the whole the New Town planning is much too open and, as I tried to point out, much too draughty, and that with concentrated and intensive study and a great deal of feeling it could be pulled together a great deal and made very much more homely. I think the densities of populations could quite easily be increased by quite a large percentage. I do not think I can go further than this unless I give you a detailed lecture on housing layout.

MR. JULIAN E. H. MUSTOE: I should like to ask how in practice these towns can work out, in terms of different types of housing for different age and social groups. Have people shown considerable preference for one type of house? To what extent do they regard the town as a real community where they work, play and live?

THE LECTURER: I can only speak for Harlow. I should not like to be too specific about this because it might be misleading. Every new town has a population which is entirely out of social balance; if a social survey were made now, you would get a reaction from one section of the community only. At the moment the majority are the young married couples with young children. There are very few adolescents, and there are not any older people. So one cannot really get a representative survey until a social balance has been struck—which it will be in time, of course.

Without much doubt, everybody in a new town would like a detached house, just as everybody in an old town does. But the issue is, can you afford to give each a detached house, and if you did, would the inhabitants like the town? Would they then think it was too spread-out? The problem really is to strike a balance between the two. If you take away the private garden, then you are restricting freedom, and there would be an outcry. The terraced house at an economical rent is a type of dwelling which people in general seem to like, but there is a natural desire for a house at the end of the terrace. The community structure which has been built up—Mr. White, our social development officer, really should be talking on this—is quite remarkable. In a very short time there were more than sixty different sorts of clubs or associations for them, and the community life is now very flourishing. There is no going back to London for entertainment; the population finds its enjoyment in its own neighbourhood.

Whereas in the first place the folk make the environment, the environment also tends to change the folk. You will find that the preference of somebody coming into the town is for the obvious house with the bay window, but after a time they get used to it, and lean towards what they call 'something a bit more modern'.

MR. G. VIVIAN DAVIES: What I feel about the new towns (and I include Harlow) is that they are too functional, too cold, bleak, unfriendly and characterless. It may be, of course, that they are new, and that as they mature people will improve them a little—they may obtain a character of their own. I may be a reactionary, but I feel that some of the factory treatment one sees along the Great West Road is preferable. I mean the stretch where the factories are of different materials and design; they have a character which is pleasing to the eye. Surely this is far better than having everything so much the same, with endless repetition which gives a bleak and unfriendly appearance.

COLONEL K. G. POST, C.B.E., T.D. (Secretary, The Civic Trust): I wonder if Mr. Davies likes the housing development along the Great West Road as much as he likes the factories.

MR. G. VIVIAN DAVIES: Surely I made it clear that I was referring to factories, and not to housing.

THE LECTURER: It is kind of Colonel Post to come to my rescue! If Mr. Davies cannot see, I cannot help him.

MR. ARNOLD WHITTICK: I have visited many of the new towns and have derived a feeling of architectural pleasure from them; but one of the things which

has disturbed me very much is the long terraced block. Mr. Gibberd seems rather to excuse the architect for the effect of these long terraced blocks, because the subject of design is not so good as the subject of design in Bath, where the effect is so much better; but I feel it is a matter of the character of the unit and its repetition. There should be a definite limit to the repetition of the small unit of the terraced houses in the new towns. I am thinking particularly of some blocks at Basildon and Harlow. These units will stand so much repetition and no more, but they have been extended in a very monotonous and wearying way. Surely it would not have been too costly to have arrested that repetition earlier?

THE LECTURER: I think there is no limit to the length of a terrace. It is really a question of the proportion. I was not making excuses on behalf of architects for two-storey terraces, I was encouraging them. I think they have done an excellent job in making the terrace as long and as bold as they have. The trouble is, that there it is not high enough. The terraces are extraordinarily long, they would be more effective if they were higher, the scale would be better and they would be better related to the space in front of them. I see no harm at all in the length, it is entirely a matter of architectural design.

I cannot deal so easily with the problem of monotony. I have tried to cover it in my lecture by suggesting that different architects should create different areas.

MAJOR W. V. G. FUGE: Is it really quite up to date to oblige people to live so very close together as they are living in these new towns? The space between the houses is very small. The houses themselves are congested. Does Mr. Gibberd think this is a better system than the open plan type of town you get in America (for example, in Los Angeles)?

THE LECTURER: The open type of plan in Los Angeles is intended for a different way of life. It results from subdividing an area into a series of individual house plots, on each of which a person puts a detached bungalow. It is not in any way a community structure. This problem of closeness is complex; it has to do with the problem of land values in this country, with the problem of urban sprawl and with the problem of keeping some quality in the design of towns. On the one hand, in St. Pancras, you are forced to house two hundred people to the acre; and on the other hand, in a new town, you are told that it is very bad to house more than sixty to the acre; in both cases the people are Londoners. Probably somewhere between those two lies a reasonable environment that this country can afford. I do not think that the majority of people really want large gardens. But that is a subject for another lecture.

MR. L. N. FRASER (Deputy County Planning Adviser, Essex): Talking about materials: I think one difficulty is that the man in the street (or the man with a house in Paddington) is used to brickwork and stonework, and so finds it difficult to accept large areas of curtain walling, glass and glazing, of various colours. I understand that recently there has been some doubt expressed as to whether that type of structure is cheaper than brickwork. Some of these towns, Crawley for example, have not gone in for this type of structure so much as Harlow or Basildon. Does Mr. Gibberd feel that familiarity with accepted traditional materials makes it difficult for people to accept a new urban scene created in the new towns by exclusive use of non-traditional materials?

THE LECTURER: I do not honestly think that in Harlow there has been any desire to use a particular kind of material. Most of the houses are of either traditional brick or cement construction. It is true that materials like curtain walls have appeared in the town centre, because we thought they were appropriate for that particular scene—not because we wanted it to be modern. I think the right technique is to make models, reasonable models, to scale, and then with a little persuasiveness I have found the design generally acceptable.

MR. MAX LOCK: I notice that in Harlow particularly there has been a great increase in the degree of co-ordination attained between the various architects who are called in to design housing schemes. It would be very interesting if we could hear a little about the task of co-ordinating the lay outs of the various architects within the framework of the new town centre.

THE LECTURER: It is an extremely difficult matter. Fortunately we have had some quite brilliant architects working for us. They more or less thought alike and, on the whole, just because they are good architects their work has come together. Although I have to approve designs, I have been careful not to interfere unduly with the ideas of other architects. My function is to care for the total picture; it is up to the architects to be themselves. In so far as the physical side of co-ordination is involved it is the Executive Architect who is responsible—and I think he has been good very indeed at it.

MISS B. D. SPENCER: Mr. Gibberd said that people are going to stay in the towns. Yet has he provided for a site near the central part of the town for a welfare home for old people in, say, twenty or forty years' time?

THE LECTURER: Yes, the County Council have a scheme, covering the whole of the town, for old people's homes, and of course there are large numbers of small dwellings which are built for that purpose.

BRIGADIER J. L. P. MACNAIR (in the Chair): I have been asked to apologize for the departure of Sir Alfred Bossom, who has unfortunately been unexpectedly called away, leaving in my inadequate hands the pleasant duty of asking you to accord a very hearty vote of thanks to Mr. Gibberd for his most interesting lecture.

I think you will agree that we have had a very stimulating afternoon. It is easy, when listening to a lecture like this, and looking at the fine lantern slides which accompanied it, to feel not only a sense of interest and appreciation, but also, inevitably there spring to mind points of criticism, inherent in the vast enterprise which has been so ably depicted by Mr. Gibberd. Some of these points of criticism have been hinted at by the lecturer himself; others are implied by contributions made by people in this hall. I know myself that, while fully appreciating all the work that is being done, there are several matters of policy about which I have doubts. This is not the place nor the time to adumbrate them, but I should like to mention just one, and that is this. Old towns and villages have all grown up round a centre of interest, which has generally been the Manor House: a Manor House where somebody with the disreputable outlook of a privileged class lived. Well, of course, it is not now accepted that there should be any privileged people in the country; but I feel that they were in fact a valuable class of person; a class carrying not only privileges, but responsibilities; and one thing that is lacking in all these modern towns is any centre of what used to be called privilege, but which might now be called social interest. I have spoken to people in the Ministry of Housing and Local Government about this very point, and I have been told that this aspect of social life is receiving consideration in new designs; but I have not so far seen it in action, other than in a sort of segregated area where a few more expensive souls live a life of their own, with no inherent obligations to the community other than those undertaken of their own choice. In some of these charming and skilful pictures which we were shown I should have liked to see some house where that horrible chap known as the boss lives; a really nice big house, perhaps with a big garden.

We have had an extremely interesting, provocative and suggestive lecture, and we are most grateful to Mr. Gibberd for all the trouble he has gone to in preparing it and coming to speak to us to-day. And I would like to add our thanks to those in the hall who have contributed to the discussion. I ask you to show your appreciation in the usual way.

The vote of thanks to the Lecturer was carried with acclamation and, another having been accorded to the Chairman, the meeting then ended.

NEW ZEALAND'S POLITICAL TRADITIONS

A paper by

K. J. SCOTT, M.A., LL.B., D.P.A.,

Associate Professor of Political Science, Victoria University of Wellington, New Zealand, read to the Commonwealth Section of the Society on Thursday, 9th January, 1958, with His Excellency The Honourable Sir Clifton Webb, K.C.M.G., Q.C., High Commissioner for New Zealand, in the Chair

THE CHAIRMAN: I have much pleasure in introducing Professor Scott, of the Political Science Department of the Victoria University of Wellington. Our university structure in New Zealand has recently been re-modelled, and what was a few months ago Victoria University College of the University of New Zealand is now the Victoria University of Wellington. Professor Scott has more than an academic knowledge of the New Zealand system of government. After completing his university studies, he spent 13 years in the New Zealand Public Service, working in a number of departments. In 1946 he took up an academic career at Victoria College. Professor Scott spent a year at Oxford in 1950–51.

The following paper was then read:

THE PAPER

In this ancient land, the term 'traditions' may seem an odd one to apply to as young a country as New Zealand. But we are one of the senior members of the Commonwealth. Two years ago we celebrated the centenary of the establishment of responsible government in New Zealand. A hundred years is perhaps long enough for the establishment of distinctive political traditions. Now it is not easy to know how to think about a period of one hundred years in politics. What sort of imaginative sweep do we need? Is 1856 shrouded in the mists of antiquity, or was it just the other day?

If we think of personal links with the early years, 1856 does not seem long ago. A personal link I have—and I suppose most New Zealanders of my generation could think of similar links—is this: in the 1920s I received a school prize from the hands of Sir Robert Stout, who had served in Cabinet in the 1870s under Sir George Grey, who first arrived in New Zealand as Governor in 1845, 113 years ago. One New Zealander who can claim a more direct link with the early years is our recent Prime Minister, the present Leader of the Opposition, Mr. Holyoake, who incidentally is descended from a collateral branch of the family of George Jacob Holyoake, the founder of the English Co-operative Movement. On an earlier visit to England I attended a political meeting in Holyoake Hall in

Headington, outside Oxford. Mr. Holyoake at present is Member for Pahiatua, in the North Island. Earlier he was Member for Motueka, near Nelson in the South Island. Some years ago, as local Member, he unveiled a monument to the early settlers of Nelson, and in his audience was his 99-year-old great-great-uncle, who had been carried ashore as a babe-in-arms that morning in 1842 when the first settlers landed in Nelson, now 116 years ago. 'Nelson' is a lustrous name New Zealand is proud to have borrowed, but I like to think that fresh lustre was added to it when a distinguished son of New Zealand chose the title Baron Rutherford of Nelson, New Zealand. Perhaps the reason I slip that in is that Ernest Rutherford and I attended the same school, Nelson College. Finally, I should like to give an exclusively political illustration of the brevity of 100 years. New Zealand's political history since 1856 is spanned by the active careers of only three politicians, the last of them our present Prime Minister, Mr. Nash. Mr. Nash is not only one of the senior Members of the New Zealand Parliament. He is also one of the senior Ministers of the Commonwealth. When the Queen Mother visits New Zealand next month she will be welcomed by a Prime Minister who was once one of King George V's New Zealand Ministers. Sir Frederick Whitaker, one of our Chairman's predecessors as Attorney-General, was a Member of Cabinet at intervals from 1856 to 1891; Sir Joseph Ward was a Member of Cabinet at intervals from 1891 to 1930; and Mr. Nash has been in Parliament continuously since 1929. When we consider the ways the present generation of New Zealanders can be linked with 1856 and even earlier years, 102 years does not seem a very long period of time.

And yet it has been long enough for a succession of minor political changes to build up in the aggregate to a complete transformation of politics. New Zealand has become fully self-governing. The Governor's powers have been whittled away until the Governor-General to-day is only the formal head of a parliamentary democracy. Parliament, whose powers were restricted under the Constitution Act of 1852, now has unfettered legislative powers. The Legislative Council has been abolished, and we have a unicameral legislature. Cabinet has become responsible not so much to Parliament as to the electorate, and it is the electorate that decides through the party system who is to form the Government. The franchise has been extended. The functions of the State have greatly expanded. One hundred years ago the Government hardly existed outside the Capital. To-day we have state enterprise dating from the 1870s, welfare measures dating from the 1890s, and economic controls dating from the 1930s. The public service has expanded from a handful of customs officers and land commissioners to a mammoth organization, recently presided over by Mr. R. M. Campbell, that deserves much of the credit for the amplitude of the amenities of life in New Zealand. The provinces that originally overshadowed the central Government have been abolished, and the local authorities that succeeded them have few functions to-day save the provision of local physical services. In short, a hundred years of political development has produced a political system that would have seemed fantastic to the pioneers of a hundred years ago. Of course, we have much the same set of political institutions still, but we operate them in

different ways and for different purposes. Reversing the French dictum, we can say that the more things are the same, the more they change.

The changes I have listed are not ones that would surprise an English audience. Your political development in the same period has been remarkably similar. Here, too, most of the Crown's powers have passed to the Ministry. Cabinet has become almost directly responsible to an expanded electorate, and the central Government has assumed responsibility for welfare, for the operation of some vital industries, and for economic planning. To-day the New Zealand political system is the one that most closely resembles that of the United Kingdom. Unlike Australia and Canada and some of the newer members of the Commonwealth, we have a unitary and not a federal state. Unlike South Africa and Canada we have no important cleavages of race or religion. Unlike the newer parts of the Commonwealth we have a long tradition of parliamentary democracy. We alone are like the United Kingdom in having what is called an unwritten Constitution. We alone are like the United Kingdom in having a two-party system based largely, but not exclusively, on economic divisions. The notable thing about New Zealand's political development is not that we have established a national tradition, but that the tradition we have established is so similar to the one you have established in the same period. What has governed our politics is apparently not so much the spirit of place, moulding our political system to meet local conditions, as the spirit of time, continually reshaping it to meet the new needs of new generations. And New Zealanders have had the same sorts of new political needs as Englishmen have had.

Nor is this surprising. New Zealanders often boast that they are more English than the English. One at least of our cities we think of as very English, and to sentimental colonials for whom England is typified by her cathedral cities, Christchurch is very English, with its cathedral at the central cross-roads, with its grey stone public buildings, with its meandering stream that is even called the Avon, with its deciduous trees that are not common elsewhere in a country of evergreens, with its Hagley Park named a hundred years ago after the ancestral home of our present Governor-General. As our political bonds with England have loosened, our sentimental bonds have tightened. Perhaps it would be more correct to say that our non-political bonds have changed their nature. I have observed the process in my own time. Earlier, England was home: it was the place one came from, or the place one's parents came from. Filial piety required a pilgrimage, though cruel circumstance usually forbade it. To-day home is New Zealand, a little Pacific nation with its own traditions, its own culture. But we are a nation that has hived off from an older one, our traditions are the continuation of English traditions in another place, our culture is a continuation of English culture in another place. It is no longer filial piety that sends us off to England, but a historically-minded desire to understand our own nature better by observing our origins, a curiosity to examine the macrocosm of which New Zealand is the microcosm—as well, of course, as less intellectual motives: footlooseness and a craving to expand in ways that lie latent within the confines of a new country.

In particular, our political affinities with England lie deeper than the institutional parallels I have drawn. We have the same tradition of tolerance towards other people's opinions and scepticism about our own, of friendship between political opponents, of preservation of freedom outside the field of economic activity. But there is one important political difference. In the United Kingdom, aristocracy has broadened down from Reform Act to Reform Act without ever being subverted into popular government. In New Zealand we had what was virtually a householder's franchise as early as the Constitution Act of 1852, and government has always been close to the people. Here you have a ruling élite—not quite a closed caste, for new blood is always being admitted—but a corps of superior individuals who have earned respect for undertaking the responsibilities of statesmanship. We are more inclined to send typical citizens into politics, and to be cynical about politicians. Your political leaders are more likely than ours to have behind them a long family tradition of disinterested public service. They are more likely than ours to have inherited a coherent set of family political attitudes. They are more likely than ours to be acquainted with the civilizing ideas that a university transmits. They are likely to feel while in office that they are the trustees of the public welfare, while ours are more likely to feel that they are the agents of the people. It might not make much difference in practice. An aristocratic conception of the public welfare may prove to be a popular conception. And, on the other hand, giving the people what you think they will like may be identical in result with giving them what you think they ought to have.

May I illustrate this by contrasting the different paths by which we have arrived at the Welfare State? Welfare legislation appeals to British Governments for an aristocratic reason, based on the Christian concept of charity. The strong are under a duty to help the weak. In this country the social question has a long history. In the nineteenth century both parties had achievements to their credit. The Education Act of 1944 was not an attempt to dish the Whigs, but a late product of Tory paternalism. In New Zealand the origins of the Welfare State are to be found not in aristocracy but in democracy. The New Zealand reason for introducing social services is an equalitarian one. Welfare is the socializing of distribution in the interests of social justice. The people of New Zealand elected a Liberal Government in 1890 to give them welfare, and they elected a Labour Government in 1935 to give them more welfare, and each time the Government obeyed the mandate of the sovereign people.

I must not overdraw the contrast between English aristocracy and New Zealand democracy. English aristocracy is tempered by fear of the reactions of a relatively small floating vote which has often swung the political pendulum, ten times from Conservative to Liberal or vice versa in the fifty years before the First World War, and six times from Conservative to Labour or vice versa since. In New Zealand the floating vote has not been the effective section of the electorate for very long. Before 1890 the electorate was not very effective at all, for there was no clear party system enabling the electorate to hold a Government responsible, and dismiss it in a general election. From 1890 there was a twenty-year alliance between the underprivileged of town and country, and no floating

vote could unseat their Governments. Then there was a twenty-five-year alliance between farmers and urban wealth, and no floating vote could unseat their Governments. But by 1935 industrialization had reached the stage when the urban workers were able, with the aid of the lower-middle-class floating vote, to put Labour into office. Since then, the lower middle class has been the predominant class in New Zealand politics.

I think the floating vote is not so predominantly lower-middle-class in your country. Just as you have thousands of wealthy Left-wingers, and millions of Conservative working-men, so you have a floating vote in which all sections of the community are well represented, though perhaps the lower middle class predominates. In New Zealand, political opinion is more likely to reflect economic interest. We are hard-headed materialistic colonials. The farmers, and the wealthy sections in the cities, vote National without many exceptions. Working-men vote Labour, without many exceptions. The floating vote, though as with you it comes from all sections, is more predominantly a lower-middle-class vote of shopkeepers, foremen, clerks, public servants, school teachers. The Depression drove them Left in 1935 and they voted Labour. By 1949 they thought their margin over the working class was disappearing, and they voted National. The promise of an income-tax rebate enticed them to the Left last year and they voted Labour. They are the tax-conscious class, the class who make Poujadists in France. The election of 1957 was altogether exceptional. Normally a party cannot do much to attract a tax-conscious class. The Government needs revenue, and must get it. But just once in a country's history, when the introduction of PAYE is being planned, there is an extra year's taxation that can be collected or not as the Government chooses. 1957 was that unique year in the history of New Zealand. In other election years there is no material offer that is welcome to the whole of the lower middle-class. They are too heterogeneous economically to have any economic interest in common. Some are employers, some employees, some self-employed. Some are in the public services, some in industry, some in commerce. They cover a wide range of wealth and of income of family responsibilities. Many of them are unable to decide, as farmers and trade-unionists can, which party would give them greater material benefits. They are disinterested economically, and this enables them to take an objective view of the public welfare and choose the party they conscientiously think will govern best. They are fair-minded, and they do not like to see a Government putting through too much class legislation, as they term it. If a Government has a large majority it can put through a good deal of class legislation, and still hope to be returned in the next election. Gladstone had a majority of over 100 in 1868 and in the six years he was in office he dissipated it by enacting party policy. It was said that he had spent his majority like a gentleman. A New Zealand Government tends to be a little more parsimonious with its majority. It instinctively tries to calculate how much class legislation it can safely put through without endangering its majority. The Labour Government was much more fruitful of reforms in the 1930s than it was from 1946 to 1949, when it had a majority of only 3 (after the election of the Speaker). In fact, from 1946 to 1949 the Government was

trying so hard to avoid class legislation that the unions were thoroughly dissatisfied with it, while the dairy farmers were delighted with a new dairy produce marketing authority introduced to give more control to the farmers themselves. Our new Government, with its majority (after the election of the Speaker) of only one, apart from fulfilling election pledges, might not do much that the National Party would not do if it were in office with an equally narrow majority. The floating vote not only decides which party is to be in office, but also how large its majority is to be. It thus determines which party is to have the chance to pass class legislation, and how much class legislation it will dare to pass. The floating vote's part in the electoral machinery is not just that of a spanner in the works on election day, but that of a regulator, a governor, in constant operation. Party government in New Zealand may look like government in one sectional interest or the other, but it can more truly be described as government calculated to please those who are economically disinterested. This is something close to the rule of reason in politics. The system enshrines that supremacy of the economically disinterested that Aristotle thought was the supreme merit of the kind of constitution he called the polity. And it holds the balance between the two sections of the community with just the neatness that John Stuart Mill desired.

It is appropriate that fear of what the lower middle class may think should be the determining factor in our politics, for it is also the determining factor in our social life. We are a very conventional community. We do not have our fair share of the crackpots who do so much to make life more interesting for other people. I suggested earlier that one reason why young New Zealanders like to travel to-day is that life takes on ampler dimensions in older countries.

Conformity is an aspect of our equalitarianism. New Zealand is often described as an equalitarian country. Leslie Lipson, who wrote the fullest account we have of our political system, entitled his book *The Politics of Equality*. Certainly we are equalitarian by English standards. Most of us live much the same sort of lives in what we could almost call a classless society. We certainly do not have your social stratification. We do not have a civil service stratified like yours. We do not have your double set of economic standards, by which a working-class family can be comfortably off on £15 a week and a middle-class family miserably poor on £25. We do not, as you do, have two parallel educational systems. Again, we do not, as you do, have two different languages: U and non-U. Perhaps in saying this I am describing a path of social development that New Zealand has trodden in advance of the United Kingdom. Your Labour Party has achieved its goals of nationalization, and many of its welfare goals. It is interested in the further reduction of economic inequalities. It is also looking for new goals. The Labour Party was created to pursue certain policies, and is now seeking policies to pursue. One school of thought suggests that Labour should take as a new goal the establishment of a classless society through educational reforms. Both economically and educationally, New Zealand is a working model of the Utopia your Labour Party is seeking to establish here. So perhaps I might examine some of the economic and educational manifestations of equalitarianism in New Zealand.

Economically there would be some approximation to equality in New Zealand even if we did not have a Welfare State. Pioneering conditions tend to create a rough uniformity. There are some wool-barons, but our dairy farmers run modest establishments. There are few big enterprises in New Zealand in which large personal fortunes could be accumulated. Most of the biggest enterprises are owned by the State—for instance, railways, civil aviation, electric power. And within the sector of private economy there is geographical fragmentation. New Zealand is a series of small communities, most of them scattered round the coasts, and most factories manufacture for the local market only. The material conditions for producing great disparities of wealth do not exist. And coupled with these levelling tendencies in the productive system are the levelling tendencies placed in the distributive system by the Welfare State. Our welfare measures are more extensive than yours. Thus your family allowance is 8*s* per week subject to tax for every child after the first, and ours is 10*s* per week tax-free for every child. Your old-age pension is £2 a week and our age benefit is £4 2*s* 6*d* per week for a single person and £3 17*s* 6*d* per week each for a married couple. Our age benefit, like your old age pension, is subject to means test and is payable at the age of 60. We also have an alternative benefit, Universal Superannuation, payable without means test at the age of 65. Our social security bill is a heavy one. In 1956–7 our bill for social security and health and education services came to 13.4 per cent of the national income. It might be asked whether the taxes required to finance an expenditure of this order might not remove the worthwhile incentives from our economic system. I recall an article called 'The Dynamic Society' that appeared in *The Times Literary Supplement* a year or two ago, in which the author said that Western Europe should abandon hope of economic development, since it is not willing to use carrots the way the Americans do or sticks the way the Russians do. How much the more strongly would the author have said the same things of New Zealand, or of a United Kingdom that planned to follow in the steps of New Zealand! But the record does not justify these forebodings. I am indebted to Mr. John Baker, Deputy Government Statistician of New Zealand, for some figures about economic development in New Zealand. The Social Security Act was passed in 1938, and Mr. Baker takes 1938–9 as his base year. From 1938–9 to 1955–6 the volume of production in New Zealand rose by an average of 3.2 per cent per annum, or, allowing for the growth in population, by 1.4 per cent per annum per head of population aged 15 to 64. The proportion of the national income going into capital investment is equally reassuring. In the year 1955, private investment as a percentage of the gross national product amounted to 15 per cent in the United States, 14 per cent in New Zealand and 13 per cent in the United Kingdom. It is not possible to draw exact analogies from New Zealand to the United Kingdom. For one thing, you have an ageing population and we do not. But the New Zealand experience does suggest that a high level of welfare expenditure is consistent with continued economic development. Mr. Baker would further say that welfare measures actually promote economic development. Redistribution from saving groups to spending groups stimulates demand and creates mildly inflationary conditions

in which profit-earning groups are able to set aside large sums for investment.

As for education, New Zealand experience does suggest that there are dangers in equalitarian policies. It is a New Zealand myth that to treat people otherwise than all alike is undemocratic. To promote children from class to class in the primary school in accordance with their ability is undemocratic. Instead we have what is called social promotion, a system under which all children are promoted at the same age, and the bright are kept back with the mediocre. Our secondary schools until twenty years ago were modelled on the English grammar school. In the later 1930s two waves of reform submerged the old system. One was a wave of political reform; the Labour Government raised the school-leaving age from 13 to 15 and was willing to see the curriculum extended for the benefit of pupils who would not be proceeding to University education. The other was a wave of technical reform initiated by a new generation of educational administrators who stressed the social rather than the intellectual function of the schools. The function of the schools was to produce well-integrated individuals who would fit easily into the community in which they were to live. Each child was to be provided with the kind of education appropriate for him. The social goals have been attained, but an unforeseen concomitant has been a failure to provide the intensive academic education that is appropriate for gifted children. There is one set of figures that suggests strongly that the general standards of education of gifted children have fallen sharply over these years, and that they are the underprivileged children of to-day. Children who spend two years in the sixth form in a good school may sit a competitive examination conducted on a nation-wide basis —the University Entrance Scholarship Examination. Until the educational reforms, entrance scholarships were widely scattered over the secondary schools of the Dominion. In 1956, the last year for which I have figures, one school—the Auckland Grammar School—which has maintained its old standards gained seven of the first twelve Entrance Scholarships and very nearly half of the total number. If it is assumed that standards that can be attained by pupils drawn from one small area could also be attained by pupils in other parts of the country, then it must follow that the other secondary schools of New Zealand are doing much less for their gifted pupils than they used to do. I do not welcome this. If we are going to need scientists rather than infantrymen, technicians rather than mill hands, Shell executives rather than commercial travellers, administrators and back-room boys rather than public service clerks, then our future welfare is going to depend largely on the skill with which we select and develop the talent that enters our schools. England has developed this skill to a superlative degree. Equalitarianism has prevented New Zealand from profiting from your example.

Finally, I should like to mention one political innovation we have made in New Zealand. This is the abolition of the Legislative Council in 1950. I mention it because you possibly expect me to, but I do not intend to discuss it at length. I could narrate the events leading to abolition, but I doubt whether they would be of much interest. Our upper house differed so widely from yours in composition and powers that I could say nothing that would throw any light on the

problem of the Lords. Perhaps I could just say that the important date in the history of the Legislative Council is not 1950, when the Council ceased to exist, but 1894, when it decided that it could no longer succeed in resisting the wishes of a determined lower house. So the question of upper houses is not quite so important a topical question in New Zealand as the date of abolition might suggest.

In summary, I would say that the New Zealand political tradition is a very English tradition. Most of the differences between the political systems of our two countries stem from a social difference, that you have a stratified society and we have an equalitarian society. Our two countries could well pursue a common goal, the establishment of a just society. Social efficiency can be attained only in a society that is justly unequal.

DISCUSSION

THE CHAIRMAN: Professor Scott commented on the declining power of the local authorities—city councils, borough councils, town boards and county councils. Does he think that there is a tendency to over-centralization in New Zealand; and if so, has he any remedy?

THE LECTURER: I certainly think there is a tendency to centralization in New Zealand, but whether there is a tendency to over-centralization is a more difficult question.

It is often supposed that democracy is found in local government and that the smaller the political unit the more efficient the democracy. I sometimes take a minority view on this. I wonder whether it is a correct view. There are two kinds of democracy, which I might distinguish as self-government and responsible government. Under a system of self-government the members of the democratic organization make their policy decisions themselves. (You get such a system in a football club, where important decisions are made at an annual meeting and the committee does nothing more than administer the policies which have been settled by the rank and file of the membership.) On the other hand, there is responsible government, which you get in a State, where the policy decisions are made by a handful of people, the Cabinet, in a responsible way, knowing they can be dismissed by the electorate. It is the party system that makes responsible government work. Now in local government, in New Zealand as in England, there is a tendency to criticize party alignments; but I think that without party in local government you cannot get responsibility, and that where there are no large local areas the party system cannot work properly. Some of our biggest areas, like Wellington City, are good democratic units because they are to some extent miniature States; and some of our smaller units, like some of our countries, are good democratic units because the important issues, such as those connected with raising loans, are decided by ratepayers at a poll. As for the intermediate kind of local government, I see no reason in democratic principle why it is more democratic to have electricity supplied by electric power boards, for instance, rather than by branches of a State electricity department. That is a minority view.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C. (Chairman, Commonwealth Section Committee): Towards the end of his interesting address, Professor Scott warned us against the effect on education of the egalitarian principle as practised in New Zealand. While, of course, grateful to our lecturer for the warning, I doubt whether the same situation could arise in the United Kingdom.

As I see it, the Butler Education Act of 1944 (an all-party measure) aimed at keeping

children at school until they were 15, and at making education free in all secondary schools. Local education authorities vary somewhat in their views in different areas.

With a few possible exceptions, however, it can be claimed that the policy in the United Kingdom is to give every encouragement to school children to reach the sixth form, to remain on at school until the age of 18, and to take every opportunity of further education offered, particularly in science and technology, either at universities or at technical colleges, in order to offset the increasingly heavy demands for workers in these fields.

To give just one example, in the L.C.C. area of London alone, with a population of about four million and where the number of school children equals that of both North and South Islands of New Zealand, approximately 850 students will be given major county awards in 1957/8 for degree courses. Of these 350 will be at London University, 100 at Oxford and Cambridge, 250 at provincial universities and 150 at London polytechnics.

Our experts in Education, would, I think, be able to reassure Professor Scott that there is no question of debasing the educational currency in Great Britain.

THE CHAIRMAN: May I announce that the next questioner is Mr. Sexton, an old school friend of mine, a fellow professional, a barrister from Auckland, as I was, and also for a time a Member of Parliament in New Zealand.

MR. A. C. A. SEXTON: With regard to our system of local government, I should like to ask Professor Scott whether he can see any solution to a problem which I think our Chairman has encountered, and that is the inability of the ordinary citizen, or the people representing him, as it were to 'get at' the officers of the local body when the latter have made an adverse decision? I am thinking of the Auckland City Council and similar bodies. There is really no means of getting a decision reversed because there is nobody among the elected representatives of the people particularly interested. If you are not satisfied with a decision of a government officer you can go to your Member of Parliament, you can go to the Minister, and ultimately you can petition the House. Even if that does not do much good, I think it has this effect: that there is nothing that departmental officers dislike more than being dragged out in the open before a Committee of the House.

My experience, at any rate with local body officers, is that you have no similar remedies, because the elected representatives on the City Council are not prepared to 'take on' their officers in the way that elected representatives to Parliament are.

Secondly, can Professor Scott see a solution to the problem of the demands made upon the time of local body representatives? He referred to the Wellington City Council, and the same thing, of course, happens in Auckland and the other larger cities, where time demands are so great now that very many men who would otherwise be willing to serve on those bodies find they are just unable to neglect their other businesses to the extent that will be required.

THE LECTURER: I have had the feeling that the central administration is more sensitive to public unease than local administration, and I was very interested to hear Mr. Sexton's corroboration of that. As to his second question, I am afraid I do not know what the solution is; but there are bigger municipalities in the world where I suppose more authority is devolved on officials. In the London County Council I suppose more authority is devolved on officials than in the smaller bodies of New Zealand.

MR. SEXTON: I imagine that would make the situation I first examined worse.

THE LECTURER: Yes, exactly; that is the dilemma of local government. To the extent that they have efficiency they lack sensitivity.

MR. SEXTON: I do not know that government by local officials is necessarily more efficient, but I will not pursue this point!

MR. G. L. DAVIES (General Manager, National Bank of New Zealand): I was interested to hear Professor Scott state (based on some figures taken by, I think he said, the Government Statistician from 1939 to 1955) that social welfare stimulates economic development. Does he affirm, as an economic fact, that social welfare stimulates capital or economic development? And if he does so affirm, does he consider that the period 1939–55 is long enough to base such a judgement on—bearing in mind the five years of war and probably six to ten years of exceptional structural development following that war?

THE LECTURER: I acknowledge my authority with gratitude. I was citing Mr. Baker's statement: 1938/9 to 1955/6 is a fairly substantial period. It is a period in which—to give some more figures of Mr. Baker's—the national income per head for New Zealand, converted into U.S.A. dollars, rose from 475 to 1,103. The national income per head more than doubled in that period. Though the period may be short the amount of economic development was extensive. I do not suppose motor cars, telephones, or average daily intake of calories would be regarded as so significant, but there are very large increases there too. Perhaps post-war figures would be more significant, excluding the war years, to see what the development was from, say, 1946/7 to 1955/6. I have Mr. Baker's figures for those years. The increase per annum in volume of production was 4·1 per cent, as against 3·2 per cent for the longer period 1938/9 to 1955/6. The increase per annum in volume of production per head of population of working age, i.e., from 15 to 64, was 1·9 per cent for the post-war period of 1946/7 to 1955/6, as against 1·4 per cent for the longer period 1938/9 to 1955/6. It looks as though development was more intensive during the post-war years than during the wartime years.

MR. F. W. HOLMES: I think the previous questioner may have felt, as I did, that Professor Scott was perhaps suggesting that social welfare was the basic element in economic development in New Zealand in recent years. I believe that we have been able to sustain the rate of development in New Zealand, and to put up with the mild inflation, only because this has been an exceptional period, and because we have obtained continually rising prices for our main export products during that period. I do not believe that we should have had the same amount of welfare and development if the market conditions overseas had been different; and that is the problem with which our new Government is faced—the market conditions for some of our major products are very different from those which obtained when the first Labour Government came into office.

THE LECTURER: I should be very glad if my innocent remarks—I am not an economist—were read in the light of what Mr. Davies and Mr. Holmes have said.

MISS LESLIE GREENE: Professor Scott spoke about Cabinet being directly responsible to the electorate, rather than to Parliament, and he went on to say that he thought the same thing was happening in this country. I do not agree, and I wonder if he would expand on that point.

THE LECTURER: I should distinguish between, on the one hand, periods in the nineteenth century in both our countries when party discipline in the House, of Commons was not very strict, backbenchers would cross the floor of the House and a Government that had a majority one week might find itself without a majority the next; between this and the later period in which most changes of government were instituted by electoral action. The critical dates in the United Kingdom would be: 1834, when a minority Government of the King's party was unable to win a general

election and had to resign; and 1868, more important still, when Disraeli lost his majority in the general election and resigned immediately after the election without waiting to be defeated in the House, because his defeat in the House was inevitable. On every occasion since 1868 when a single Opposition party has captured a majority of the seats in the Commons in a general election the Government has resigned without waiting to be defeated in the House.

The story in New Zealand is similar, though the dates are a little different. It was not until 1890 that a majority Government was defeated in a general election. It was not until 1935 that a Government resigned before being defeated in the House. The 1935 date corresponds to the 1868 date in the United Kingdom. In both countries, Governments that are defeated nowadays are defeated by the electorate, not by the independent action of Members of Parliament who have changed their minds, who have changed their party alliegance, or abandoned the party alliegance under which they have been elected. It is Members of Parliament being loyal to their electors that brings about changes in government. If we looked at the middle of the nineteenth century we should find that changes of government took place between elections and not as a result of the defeat of a Government in an election.

PROFESSOR C. E. CARRINGTON: May I ask Professor Scott a small constitutional point? I wonder whether he would say a word or two about the recent attempt to safeguard democracy by entrenching the electoral law?

THE LECTURER: The question concerns the Electoral Act of 1956, by which an interesting constitutional innovation was made in New Zealand. Over the preceding generation there had been occasions when Governments had employed their temporary majorities to amend the law on parliamentary representation. A notable example of this occurred in 1932, when the anti-Labour coalition lengthened the life of a peace-time Parliament; and another in 1945, when the Labour Government abolished the so-called country quota, which had given the rural areas more than their proportionate share of the seats in the House. In 1956 the two parties agreed on seven basic points about parliamentary representation, and Parliament unanimously passed a new Electoral Act embodying these seven points and providing that the law relating to them might not be amended except either by a 75 per cent majority vote in Parliament, or by a majority of the electors voting in a referendum.

Now the peculiar thing about this provision was that the entrenching clause was not itself entrenched. Any future Parliament that wanted to amend any of these seven provisions could give itself the legal power to do so by repealing the entrenching clause by a simple majority. So the entrenching clause in New Zealand has no enduring legal validity, but it has a substantial moral validity. The fact that the Bill was passed unanimously registered an agreement between the two parties that the law on parliamentary representation would be regarded as sacrosanct. If a Government used the legal powers of Parliament to depart from the agreement, the Opposition would no doubt characterize its actions as unconstitutional, and such an accusation would carry a lot of weight in the next general election. One of the factors which brought about the change of Government in 1935 was that many electors thought the Government had acted unconstitutionally in extending the life of a peace-time Parliament.

It might be asked why the entrenching clause was not entrenched. What would have happened if the clause had been entrenched and a later Parliament had purported to legislate by a bare majority in defiance of it? Constitutional litigation would probably have resulted, and the judges would have been called upon to give what might have looked like a political decision, and the law on the subject might have been uncertain until the case had been carried on appeal to the Privy Council. I believe that the reason why the entrenching clause was not entrenched—the reason why the legal possibility of defying the spirit of the entrenching clause was left open—was

from a very proper desire that the judges should not only be out of politics, but should also be seen to be out of politics, and from a very proper desire that constitutional law on this important subject should be certain, should not be in a state of flux for a period perhaps of many months while a Privy Council decision was awaited.

THE CHAIRMAN: Can you tell us how, in a unicameral legislature such as we have in New Zealand, you can entrench a clause?

THE LECTURER: I agree with the National party official view, stated by the Chairman, as Attorney-General in 1950, repeated in the Constitutional Reform Committee's report in 1952 and stated again by the Chairman's successor as Attorney-General in the debate on the Electoral Bill in 1956—that it cannot be done. There is another authority for this view: the Privy Council.

It is quite clear that the New South Wales precedent of 1929 and the South African precedent of 1952 have no bearing on the situation that would arise in the United Kingdom or New Zealand if Parliament purported to legislate in defiance of an entrenching clause. There is no entrenching clause on the New Zealand Statute Book. There is one on the United Kingdom Statute Book. It is Section 4 of the Statute of Westminster, which provides that the United Kingdom Parliament may not enact a Statute extending to a Dominion as part of the law of that Dominion unless it is recited in the Statute that the Statute is passed with the advice and consent of the Dominion concerned. That is, the United Kingdom Parliament restricts itself from passing a particular kind of legislation. Now that clause reached the Privy Council in one case, the British Coal Corporation case, and the Privy Council said then (in an *obiter dictum*) that the United Kingdom Parliament has full power to legislate in defiance of Section 4 of the Statute of Westminster. I think the same would be true in New Zealand if Parliament passed what purported to be a statute by ordinary procedure in defiance of an entrenching clause, and I think the Chairman will agree.

THE CHAIRMAN: Yes, I do.

THE CHAIRMAN: We are greatly indebted to Professor Scott for his very interesting address. He chose a subject that is not an easy one to make interesting, but he has made it both interesting and stimulating. One proof of that is the pertinent questions that followed from his audience.

But there is one point on which I differ from Professor Scott (and I think my friend Mr. Sexton as an ex-member of Parliament will agree with me). He said that there were more crackpots in the United Kingdom than in New Zealand. I suppose that is actually true; but proportionately we have our fair share in New Zealand!

I have much pleasure in moving that a hearty vote of thanks be accorded to Professor Scott.

The vote of thanks to the Lecturer was carried with acclamation.

SIR SELWYN SELWYN-CLARKE: It gives me very great pleasure to second that proposal. I should also like to say how grateful we are to Sir Clifton Webb for presiding this afternoon. We are very sorry indeed to learn that we shall not have this privilege again because of his impending retirement to New Zealand. I know that I am echoing the views of the audience when I say that he will take with him our very warm wishes for a happy retirement.

On behalf of the Commonwealth Section of this Society I would add a final word to express our delight at having not only Sir Clifton Webb and Professor Scott with us, but also such a distinguished gathering of New Zealanders.

A vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

INTO SPACE

A Dr. Mann Juvenile Lecture by

PATRICK MOORE, F.R.A.S.,

Director of the Mercury and Venus Section of the British Astronomical Association, Fellow and Council Member of the British Interplanetary Society,

Wednesday, 1st January, 1958

During the past few years, space-travel has been so widely discussed that it is not always easy to form a clear picture of what has really been happening. Some authorities maintain that it will never be possible to reach other worlds, while others believe that the Moon at least will be visited within the next decade. As usual, the truth usually lies between these two extremes. We must not be pessimistic—it is worth remembering that only seventy years ago, one of America's leading astronomers proved conclusively that flight in a heavier-than-air machine would never be possible! On the other hand, it would be foolish to underestimate the difficulties of interplanetary travel. What I want to try to do this afternoon is to give you a balanced view of the whole problem.

First, let us look briefly at the Solar System in which we live. The Earth is an ordinary planet, revolving round the Sun at a distance of 93 million miles; there are eight other planets, of which the two nearest are Venus and Mars. By far the closest natural body in the sky is the Moon, which is a mere quarter of a million miles or so away from us. This is not far on the astronomical scale; an aircraft which flew ten times round the Earth's equator would have covered a distance greater than that which separates the Earth from the Moon.

Just as the Earth is an ordinary planet, so the Sun is an ordinary star. It appears particularly splendid to us simply because it is comparatively close; the nearest of the 'night-sky' stars is so distant that its light, travelling at 186,000 miles per second, takes more than 4 years to reach us. Clearly, interstellar flight is sheer fantasy in the present state of our knowledge, and I very much doubt whether it will ever be possible.

One vitally important fact is that almost the whole journey between the Earth and the Moon will have to be done in 'empty' space. Our atmosphere extends upward for only a few hundreds of miles, and this means that ordinary flying-machines such as aeroplanes (and even jets) are limited to low levels; they cannot function unless there is air around them. So we must find some means of propulsion which can manage without any surrounding atmosphere.

The idea of space-flight is by no means new. About 2,000 years ago a Greek writer named Lucian described a voyage to the Moon; in his story, a ship sailing through the Pillars of Hercules (the modern Strait of Gibraltar) was caught in a waterspout, and hurled up so violently that it ended its career on the lunar world. Lucian certainly did not mean to be taken seriously, and in fact he called

his story the *True History*, adding that it was made up of nothing but lies from beginning to end; however, it is evident that the theme of interplanetary travel is not nearly so modern as most people imagine.

Various other equally far-fetched stories were written during the following centuries, but in 1865 came a much better scheme, that of the space-gun. This was put forward by Jules Verne, the great French author, who proposed to put his voyagers inside a hollow projectile and fire them off to the Moon at a speed of 7 miles per second.

There was an excellent reason for his selecting this precise speed. If I throw a coin into the air, it will rise for a certain distance and then fall; if I give it a greater starting velocity, it will rise higher; if I could throw it at 7 miles per second, it would never come down at all—the Earth would be unable to hold it, and it would escape into space. This is why 7 miles per second is known as the Earth's escape velocity.

Unfortunately, Verne's space-gun is impracticable for several reasons. Travelling through the dense lower atmosphere at 7 miles per second would cause so much frictional heating that the projectile would be promptly destroyed; moreover, the jerk of departure would prove fatal to any human occupants.

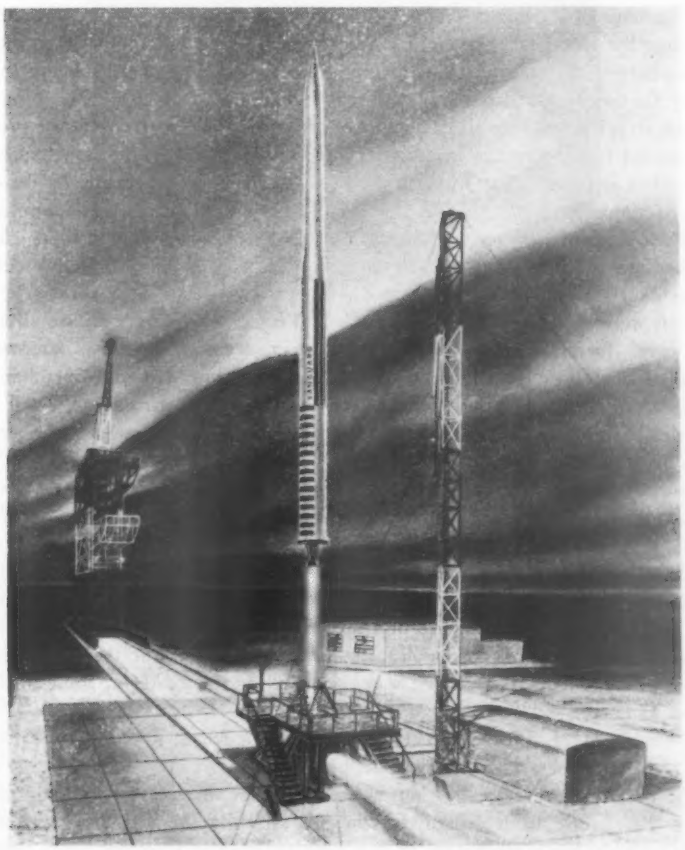
The first man to suggest a valid means of travelling at great altitudes was a Russian, Ziolkovsky, who proposed to use the power of the rocket. The ordinary Guy Fawkes rocket is made up of a tube filled with explosive; when the explosive is lighted it generates hot gas, and this gas rushes out of the exhaust hole of the rocket, so propelling the tube in the opposite direction. The principle is that of 'reaction'—every action has an equal and opposite reaction; and it will be realized that atmosphere is not needed. In fact, the rocket is at its most efficient when in outer space, since there is no air to set up resistance.

Solid fuels are weak and unreliable, but during the last thirty years liquid fuels have been developed. These are far better, though still not powerful enough to satisfy space-research scientists. The first really successful liquid-fuel rockets were built by the Germans during the last war, and used to bombard London. These 'V.2's could soar to over 100 miles, and could thus enter regions to which no aeroplane could penetrate. After the German defeat the unused rockets were taken to America, and a rocket base was established at White Sands, in New Mexico. It is probable that the Russians established similar testing grounds at about the same time.

The liquid-fuel rockets could carry explosives, but they could also carry scientific equipment—including cameras, so that for the first time it became possible to explore the upper regions of the Earth's atmosphere. Such research is important in many ways. For example, we want to study cosmic rays, high-speed particles from space which continually bombard the Earth. We cannot do so from the ground, because the original cosmic rays are blocked by the atmosphere, and only fragments reach the Earth's surface; so that rockets provide the only means of investigation. There is a definite chance that cosmic rays may prove harmful to living creatures, so that it is essential for us to find out as much as we can. Again, the Sun sends out radiation of all kinds; much

of this radiation is similarly blocked by the Earth's air, so that if we want to extend our studies of the Sun we must send instruments above the atmosphere.

Rapid progress was made. New rockets, such as the Vikings, were far better than the German V.2s, and science benefited accordingly. Before long, however, the limitations of the rocket made themselves painfully apparent. No rocket can stay up for more than a few minutes; subsequently it falls, destroying itself—while very often the instruments carried are destroyed as well, despite all precautions. In 1955 the Americans therefore announced that they intended to launch an artificial moon, or Earth Satellite, which would be able to stay up for many months, sending information back to scientists on the ground.



[*By courtesy of the Glenn L. Martin Co.*

FIGURE 1. *The Vanguard rocket which was designed to launch an American satellite*

Suppose that we take a small vehicle a few feet across, send it above the atmosphere by means of rocket power, and then give it a 'sideways kick' so that it starts moving parallel with the Earth's surface at a speed of about 5 miles per second. The vehicle will not fall down; it will continue circling the Earth without any more power being given to it. It will in fact be moving in exactly the same way in which the real Moon moves—or, for that matter, in the way in which the Earth revolves round the Sun. To all intents and purposes it will have become an astronomical body.

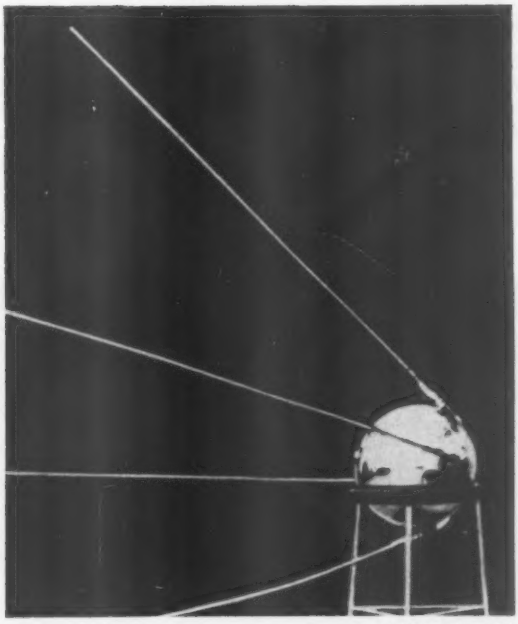
Actually, the launching procedure is not so simple as this. The vehicle used to take the satellite into its path or 'orbit' has to be a step-rocket, because even modern liquid fuels are not powerful enough for a single vehicle to be used. The best way to describe a step-rocket is to say that it consists of several independent rockets mounted one on top of the other. At the start of the flight, the large bottom rocket does all the work, and lifts its companions high into the atmosphere—accelerating so gently that there is no danger of its being burned up by friction in the same way as Verne's fictional space-projectile. When the bottom step has used up all its fuel, it breaks away and falls back to the ground; the second step continues under its own power until it, too, has exhausted its fuel, when it breaks away in turn. This leaves the third step rising by means of its own motors, and it is this final piece of the original rocket which launches the satellite. There is no sudden sideways jerk, since by the time the vehicle has reached the required height it has tilted so that it is travelling parallel with the Earth's surface.

Such were the American plans for their 'Project Vanguard'. As we all know, they were forestalled; on 4th October, 1957, Russian scientists successfully launched their first satellite, the 'Sputnik', and followed it in November with a second satellite, carrying a dog as well as scientific instruments. Both these vehicles have been of great use, and our knowledge of the upper atmosphere has been greatly increased.

However, neither of these first two Sputniks will remain in orbit forever. Their paths are elliptical, not circular; when at their nearest to the Earth they are moving at a height of less than 200 miles, where air resistance is still to be reckoned with. Gradually they will be drawn downward, until at last they will spiral back to the ground, very probably destroying themselves by frictional heat on the way. Latest reports indicate that Sputnik I may come down at any moment, while Sputnik II should last until mid-1958. The third step of the rocket which launched Sputnik I was itself circling the Earth for some time, but ended its career some weeks ago.

So far, so good. We have taken the first major steps; it is therefore time to look ahead and see what is likely to happen next.

The first earth satellites are not space-ships; let this point be clearly understood. They have been designed primarily to study the upper regions of the Earth's atmosphere. However, in the near future the Russians, and probably the Americans too, will launch more massive satellites to greater altitudes, and some of these will remain above the atmosphere for their whole orbits, so that



[*Planet News Ltd.*

FIGURE 2. *The first Russian satellite, photographed in Moscow before being sent up*

unless deliberately interfered with they will stay in their paths indefinitely. Science will benefit greatly; we have found a new research tool.

Manned flight beyond the atmosphere still lies in the future. Though animals have been sent up on rocket trips, no creature has yet been recovered from an earth satellite, and this will have to be done before we can seriously consider sending up a human being. I should not like to predict just when the first manned flight will take place, but I doubt whether it will be possible for a considerable time yet.

We cannot tell definitely whether conditions in space will be harmful to living creatures. Cosmic rays have to be taken into account, but there are other problems as well. Once in space, and in free fall, there will be no sensation of weight; at the very least this may upset the balancing organs of our 'space-man'. A true space-suit will certainly not be like the creations shown in comic papers, which always remind me of a diver's outfit with a goldfish bowl on top. There is a certain danger from high-velocity meteors . . . and so on. Anybody who thinks that we are almost ready to set off for the Moon is very wide of the mark.

However, it is quite within the bounds of possibility that an unmanned rocket may be fired to the Moon within the next few months; the technical difficulties

are great, but probably not much greater than those of launching a satellite such as Sputnik II. The only question is whether the value of such an experiment would justify the expense.

What, then, of the Moon itself? A journey there, at speeds which we envisage at the moment, would take only five days or so, but the lunar world is not likely to give us a friendly welcome. There is virtually no atmosphere and certainly no water; any form of life on the surface seems to be out of the question. The landscape consists of lofty mountains, wide grey plains termed 'seas' but which are in reality lava-beds without a scrap of moisture in them, and thousands

[*By courtesy of the Mount Wilson and Palomar Observatories*

FIGURE 3. *The Moon, a future target. This shows a typical lunar scene; the crater in the centre of the picture, Copernicus, is over 50 miles in diameter*

upon thousands of walled circular plains which are known as craters. Since there is no atmosphere, the Moon must be a world of eternal silence—remember that sound-waves are carried by air. Space-travellers of the future will have to talk to each other by means of radio, and this means that communication will be limited to the distance of the horizon. A radio station on the Moon could call up the Earth, nearly a quarter of a million miles away, but it could not call up another lunar station a mere ten miles distant. Nature can play some strange tricks on us.

The lack of atmosphere means also that the range of temperature is unpleasantly great. At mid-day on the lunar equator, the temperature is higher than that of boiling water; at night it descends to that at which ordinary air would liquefy. Moreover, the Moon turns on its axis only once in a month, so that a 'day' there is as long as a fortnight here. The surface seems to be overlaid with a layer of dust or ash, and though this layer is probably less than six inches deep we have no guarantee that the ground will not contain treacherous hollows. Altogether, the Moon is a hostile world.

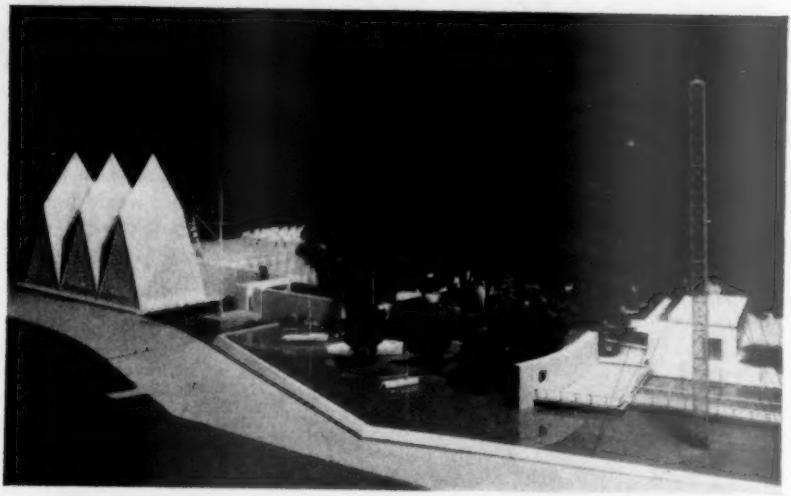
Of the planets, only Mars and Venus are close enough to be considered as possible targets. Mars is the more attractive of the two, since it has an atmosphere and may even support tracts of low-type plant life; but even on Mars the 'air' is unbreathable, and it is not now believed that any animal or human life can exist there. Venus is a most curious world, since the atmosphere consists largely of carbon dioxide, and the surface temperature is likely to be very high.

To reach Mars or Venus would mean a journey of months; add a similar amount for the return, and a period spent on the planet concerned, and we have to reckon with a total absence of more than two years. It is quite clear that there is little point in working out details until we have managed to reach the Moon—and so far even the Moon is beyond our reach.

It will not always be so. I, for one, firmly believe that the first lunar voyage will take place within the next fifty years. It will be a great achievement; it will satisfy part of our wish to 'find out more', and since it can only be carried through by means of peaceful co-operation between the scientists of all nations, it may also go some way towards uniting the Earth.

GENERAL NOTES

THE BRUSSELS EXHIBITION 1958



[Crown copyright reserved

Brussels Exhibition 1958: a general view of the model of the British Government Pavilion, showing the Crystalline Hall, the Lake, and the Courtyards of the Arts and Humanities. In the right foreground is the television mast. (Architects: Howard V. Lobb and Partners)

'The Brussels Universal and International Exhibition 1958', is the official title of the latest in the long series of international displays which began with the Great Exhibition of 1851. At these exhibitions the nations of the world have sought to emphasize the contributions which each makes to civilization, by showing the prominent features of their national life, their activities, and their products. The last international exhibition was held at New York in 1939.

In 1928 a diplomatic convention was signed by 35 countries establishing the International Exhibition Office to regulate the frequency and method of organization of world exhibitions. Two types of exhibition were defined, namely, Special Exhibitions to cover a single subject, and General Exhibitions, which were not limited in subject. If all activities were included in a General Exhibition, it was to be entitled 'Universal'.

There are 43 nations represented at the Brussels Universal Exhibition, and several supra-national bodies such as U.N.O., U.N.E.S.C.O., F.A.O., O.E.E.C. and the Council of Europe. The site is the undulating, wooded Heysel Park on the outskirts of the city, and it covers 500 acres. Belgium, as the organizing country, has the greatest amount of space, after which come the U.S.A., the U.S.S.R., France and Holland with 25,000 square metres each, and then Great Britain with 21,135 square metres, or 5 acres.

The British contribution consists of two groups of pavilions—a Government Pavilion, for which the Central Office of Information is responsible, and a British Industries Pavilion, which the Federation of British Industries is handling through its subsidiary, British Overseas Fairs Ltd.

The controlling architects, Mr. Howard V. Lobb, C.B.E., and his partner, Mr. John Ratcliff, O.B.E., together with the exhibition designer, Mr. James Gardner, O.B.E., R.D.I., are responsible for the treatment of the whole site, though their special interest is the British Government Pavilion. The architect for the British Industries Pavilion is Mr. Edward D. Mills, and its display designer is Mr. John Lansdell. The structural engineers are Felix J. Samuely and Partners.

The well-wooded site of the British Pavilion is approached from the centre of the exhibition by a rising, curved road. At once is seen the dominant feature of the Government Pavilion—the Crystalline Hall, a structure consisting of three crystal-shaped spires, 70 feet high, which form the entrance building. The flat, triangular shapes of the spires are of plywood stressed-skin construction, somewhat similar to that of an aircraft wing. The panels are only 6 inches thick and are self-supporting, without columns or framing beams. This construction has been remarkably simple to make and erect, and will be inexpensive to demolish after the exhibition.

Visitors enter under a canopy of illuminated Tudor roses past the Royal Coat-of-Arms, carved in perspex. The interior is dramatic, being painted midnight blue as a background to the brilliant spotlighting of the exhibits. These are a display of regalia, heraldry and symbols representing the continuity of tradition in contemporary Britain. A portrait of Her Majesty The Queen occupies a commanding position in the interior.

This opening display is immediately followed by a startling introduction to modern progress in the form of a huge illuminated diorama of Dounreay atomic power station—the first fast-breeder-reactor in the world. This in turn is the introduction to the Hall of Achievement, where are illustrated the scientific, industrial, cultural and social contributions and movements in which Britain has led the way, from steam engines to Z.E.T.A., from Boy Scouts to penicillin, from letter post to radar.

This hall is long, wide and low in height. There are no internal columns in the 82 feet span, the roof consisting of a space-frame in light steel tube. The walls are faced outside with flat four-sided pyramidal shapes in plywood, harmonizing with the shapes of the Crystalline Hall. At the end of the circulation is a series of animated, coloured panels depicting humorously the habits of the people of Britain.

From the Hall of Achievement the visitor passes into the Commonwealth Court, where there is a forest of 42 stainless steel masts flying the flags of the self-governing Dominions and Colonies. There follow two garden courts, planned round some forest trees, where are illustrated, in showcases, the homes, gardens, schools and universities, the arts, crafts, hobbies and pastimes of the British people. The main exit from the Government Pavilion leads over a bridge spanning a small lake on which float a cabin cruiser and boats of the latest design.

Here, on the left, is the Britannia Inn—a typical modern British pub—where the visitor can sample the liquid refreshments of Britain. Opposite is the entrance to the British Industries Pavilion, containing exhibits from the leading British manufacturers of such things as atomic energy plants, gas turbines, aircraft engines and radio equipment. It consists of six gigantic compound steel columns from which the roof springs in great steel-ribbed mushrooms. Enclosing the whole is a huge curtain wall of timber and glass, so that the building forms a great showcase housing the modern industrial products of Britain. At the end of the Industrial Pavilion is a special display by the City of London and, beyond it, a cinema in which will be shown British documentary films.

The whole group forms a series of linked and clearly-articulated building shapes which express their functions. From an expression of the power and dignity of Britain as the heart of the Commonwealth there is a natural progression to the products of an industrial and atomic civilization.

ERIC BIRD

'DESIGN PAYS' SYMPOSIUM

With the purpose of stimulating action to improve the appearance of town and countryside through the better design of private housing, the Town and Country Planning and Housing Committee of the R.I.B.A. have arranged a one-day symposium to take place at 66 Portland Place, W.1, on 2nd May, under the chairmanship of Sir Hugh Casson. It is hoped that this joint meeting of architects, builders, representatives of building societies and clients will do much to foster the understanding on which the commissioning of better design largely depends.

The meeting will be opened at 10 a.m. by the Minister of Housing and Local Government, Mr. Henry Brooke. Thereafter the symposium will examine 'The Situation', 'The Client's Needs' and 'What the Architect Can Offer'. After luncheon there will be a discussion on 'Getting Together', followed by accounts from three speakers of their own experience in building and selling better design. Mr. Paul Reilly, Deputy Director of the Council of Industrial Design, will then speak on 'The Acceptance of Present Day Design'. After tea will come the Chairman's summing up and a general discussion, under the heading, 'Taking Action'. The symposium is expected to end at 5.30 p.m.

Tickets, costing £1 each and including morning coffee, afternoon tea, and (in due course) a printed report of the proceedings, may be obtained from The Secretary, R.I.B.A., 66 Portland Place, London, W.1, who will also supply further details of the programme. Applications should be marked 'Design Pays Symposium', and should be accompanied by a cheque or postal order in payment for the number of tickets required.

1958 WAVERLEY GOLD MEDAL ESSAY COMPETITION

The Scientific Advisory Board of the monthly publication *Research* have decided to continue again this year the essay competition which they first organized under the chairmanship of the late Lord Waverley in 1953. The competition is designed to draw attention to the problem of communicating scientific information to the layman and also to scientists engaged in other fields. The Waverley Gold Medal and £100 will be awarded for the best essay of about 3,000 words based on some recent scientific research or new development (whether the author's work or not), giving some indication of the scientific background, the experimental results and its potential application in industry. The essay should be written in such a form that it is clearly intelligible to a scientist engaged in another field, or to a director of an industrial firm, and particular attention should therefore be paid to presentation and style, as well as to technical content. A second prize of £50 will be awarded, and an additional prize, also of £50, for the best entry from a competitor under 30 years of age on 31st July, 1958 (which is the closing date for the receipt of entries). The competition is only open to persons at present engaged in scientific work.

The full conditions governing the competition may be obtained from The Editor, *Research*, 4/5 Bell Yard, London, W.C.2.

THE CHANNEL TUNNEL

'Surely this Society ought to take a deep interest in the construction of a submarine tunnel which will tend to strengthen the bonds which unite two great peoples—will facilitate the interchange of commercial productions between foreign countries—promote Arts, Manufactures, and Commerce. . . .' So urged William Hawes, F.G.S., in a paper read to the Society on 20th March, 1874 (*Journal*, Vol. XXII, p. 397), when he advocated the construction of a railway tunnel 'through the grey chalk which stretches across the Straits between Dover and Calais', estimating that the cost of the preliminary works would be £160,000. With the passing of time, the

financial problems of such an undertaking increased as its engineering and technical difficulties seemed less formidable; but the topicality of the subjects remained fairly constant at least until the First World War, and, as the *Journal* shows, the Society paid particular attention to developments proposed in the period from 1869 to 1913.

In view of the recent quickening of public interest in this enterprise, Fellows may wish to know of a useful *Special Subject List* (No. 24), devoted to the Channel Tunnel, which has recently been issued by the Library Association. Compiled by Harold Smith, F.S.A., of Kensington Public Libraries, it includes bibliographies, government publications, books, pamphlets, reports and articles in periodicals published in this country in the last hundred years; amounting in all to 244 works. To judge by the titles of some of the entries, objections to the idea of a tunnel on military grounds reached a height in 1882, when, amongst others hardly less dramatic, 'Vindex' gave his account of *England Crushed . . . being the literal translation of a secret despatch recently revised and adopted by an Austrian Federal Cabinet*, and 'Grip' described *How John Bull lost London*. . . . It was persisting fears such as these which Arthur Fell, M.P. (then Chairman of the House of Commons Channel Tunnel Committee), sought to answer in a paper read to the Society in December, 1913 (*Journal*, Vol. LXII, p. 88). He then expressed a hope that if the Channel Tunnel Bill were supported by the government of the day, 'we may . . . see the work begun within two years'.

Copies of the list under notice, price *2s 6d* each, may be obtained from the Secretary, The Library Association, Chaucer House, Malet Place, London, W.C.1.

MODULAR FURNITURE

Inconspicuous amongst the 1958 collection of furnishings now on view at Heal and Son Ltd., in the Tottenham Court Road, is an assembly of sectional storage fitments which should have a decided influence on similar work in the future, for it has been designed by Mr. Christopher Heal, F.S.I.A., in accordance with the 4-inch module now internationally established. The resulting standardization of parts makes for both adaptability and economy. Three widths of wardrobe and upper cupboard have been applied in the construction, which also incorporates drawers, and fitments may be assembled of any widths over 32 inches. Scribing pieces are used to fit intermediate dimensions. In appearance, the furniture is pleasingly restrained: the designer's intention is that it should not obtrude in any room.

A CENTENARIAN FELLOW

The Society sent a telegram of congratulation to Sir James Swinburne, Bt., F.R.S., the distinguished engineer, on 28th February, the hundredth anniversary of his birthday. Since his election as a Fellow of the Society in 1896, Sir James has made a number of important contributions to its proceedings, beginning with a notable series of Cantor Lectures on 'Applied Electro-Chemistry' in April-May, 1896 (*Journal*, Vol. XLIV). Not long afterwards, Sir James began his experiments with synthetic resin, and he has been with justice described as the father of the plastics industry.

CORRESPONDENCE

ARTIFICIAL HEELS

From MR. S. C. NORRINGTON, 70 EGMONT ROAD, SURBITON, SURREY.

The human body, which begins its physically active life in a sound mechanical working condition, was designed as a combined habitation, vertical machine and

self-propelled vehicle, to stand, work and rest under all the mechanical and geometrical principles of Nature's laws and forces, gravity and rotation. I am certain that the present ignorance in the application of these laws and forces, with their condoned and flagrant violations, are the real causes of many physical and mental troubles which are generally attributed to other causes.

To-day the habit which causes the greatest amount of structural distortion to the human body is the addition of artificial heels to man's everyday footwear. These heels appear to have been introduced into this country substantially about four hundred years ago. They were at first intended for and only used by horse-riders (to help keep their feet in their stirrups), and for health reasons that should have been the limit of their use. But by the time of Charles I they had, for reasons of vanity, become a fashion which continues unchecked to-day.

Artificial heels, being superimposed additions, elevate the rear piers of the main or longitudinal arches of the feet—which arches are also designed to function not unlike laminated elliptical springs—above the natural horizontal alignment of their front piers. Suppose a normal, unshod and unmutilated average person who has never worn artificial heels to be standing naturally erect, on a solid horizontal surface, with his feet placed together side-by-side. Two imaginary, fixed, rigid horizontal planes are then placed, one under the soles of his feet, the other through his natural centre of gravity in his pelvis. Now if, when in a similar erect position, he puts on ordinary footwear which has artificial heels, the former plane will be tilted at an angle from the horizontal and the latter will be automatically tilted approximately parallel to the former. The result is that practically every limb and organ of the body in and above, as well as below, the pelvis is to some extent forced out of its normal and natural mean mechanical working position by the numerous, constant and unavoidable re-adjustments of weight which, in order to maintain balance, must be effected. If this wear is constantly persisted in, a false and unstable equilibrium will eventually become permanent, and the false mean positions of the various parts, habitual.

The lower limbs, with the pelvis, are designed, in the main, for supporting and transporting the body as a whole, without undue strain, vibration or pain to any part of it. This transportation should be effected with synchronized and co-ordinated movements of the limbs and with the minimum expenditure of mental and physical energy. The constant jarring and jolting of the body as a whole, caused by the obstruction and banging of artificial heels on the ground to any degree—rubber tips or not—is unnatural, a mechanical anomaly and, in time, unavoidably detrimental. No ordinary person when walking or running (naturally, 'heel and toe') barefooted or in stockinged feet would bang his natural heels much on the solid ground or hard floor. If anyone doubts this, let him try it. And let him note, at the same time, the rotation made by the feet at the ankles ('ankle action'): particularly that at the end of the latter half of the arc, executed by a foot, during that part of the full movement from the front to the rear, made by each lower limb as a whole. During this movement a limb, as a whole, is pivoted at the pelvis, and, when being exercised on a horizontal surface, is designed to be then automatically straightened and locked at the knee. How rarely are the knees of most people straightened, let alone locked!

The structural distortion which results from the wearing of artificial heels also gives rise to faulty habits of subconscious control. A normal healthy person who has never worn these heels is, under ordinary circumstances, relatively safe from a slipping accident when on a slippery horizontal surface. On a moderately slippery forward slope, as a rule, he will subconsciously recover his balance without losing his control or falling. But a person wearing artificial heels is very vulnerable. Many accidents occur or are predisposed, directly and indirectly, on both horizontal and other surfaces, from this fundamental cause. Excessive instability is more in evidence

as one approaches the 'later-middle' and 'old age' periods of life, and then the end results of falls are often very severe.

Other things being equal, the abolition of artificial heels would prevent certain ills and accidents happening to young, middle-aged and old alike. No sudden abolition should be considered except for the very young. For the rest, a gradual diminishing of the height of the heels, spread over many months, or even years, should be practised. Younger, more active and athletic people should take shorter periods. At the same time, the footgear should be much widened at the fore parts and the toes—particularly in respect to the big toes—and the flexibility of the footgear—especially that of the heel part of their soles—should be much increased.

'STONE SCULPTURE BY DIRECT CARVING'

From MR. C. d'O. PILKINGTON-JACKSON, A.R.S.A., F.R.B.S., 4 POLWARTH TERRACE, EDINBURGH 11.

In a letter in the *Journal* (16th August, 1957, p. 795) Mr. Mark Batten, P.R.B.S., protests that your reviewer of his recent book went beyond the bounds of propriety (*Journal*, 19th July, 1957, p. 722).

Having now reviewed this book for another editor, I feel constrained to add my support to Mr. Batten's protest. While it is true that some of your reviewer's criticism was pertinent, his general condemnation was not.

Writing as one who has carved and worked among carvers and stone-masons for upwards of forty years, I consider that Mr. Batten's book, though perforce limited in scope, has a great deal to recommend it; that it should be in every reference library and may be read with profit by experienced as well as novitiate sculptors, professional and amateur.

NOTES ON BOOKS

MODERN PUBLICITY, 1957–58. *Edited by Frank A. Mercer. London, The Studio, 1957. 42s net*

There is an ever-increasing awareness in the world to-day of the growing importance of good design in advertising. In the past such design work has tended to be regarded as a Cinderella. The designer and his ideas were tolerated rather than appreciated. Many advertisers failed to recognize that in beguiling the public the æsthetic value of this art of communication raises not only sales but also public taste. This is now seen to be the best form of public relations for a company. It bears out the dictum of the Council of Industrial Design: 'Good design is good business'.

Those who are interested in the improvement of techniques in advertising expression will find much pleasure in studying the current edition of *Modern Publicity*. Examination of this volume, which comprises 123 pages of illustrations (with some 114 examples in colour), clearly demonstrates the advances in imaginative design and in graphic techniques which are taking place to-day.

Entries are shown from thirty-three countries, as wide apart as Australia, Japan, Rhodesia, India, the United States, South Africa and many European countries, including several from behind the 'Iron Curtain'. This illustrates forcibly that imaginative advertising is not confined to any one country or even continent, and that the design interpretation of one part of the world can be just as easily understood and appreciated in another. It would be an aid to readers who are interested in studying the work of individual countries in order to compare them readily if the designers' names were listed in the index pages grouped under countries instead of the present alphabetical list for the world.

The Editor is to be congratulated on the large collection of illustrations, which

embrace every facet of advertising expression from magazine covers, press advertisements, letterheads, and book jackets to posters and packaging, including record sleeves—a comparatively new field, but one offering great opportunities for a specialized form of typographic-cum-pictorial design within a square area.

It is stimulating to see so much improvement in packaging—this augurs well for the future. Goods in gay and exciting packs do much to titillate the curiosity of a prospective buyer to see 'what's inside'. This 'wantable' quality of appearance is of growing importance with the coming in this country of the self-service store.

It is pleasing, too, to see the growing recognition of the part that good advertising design plays in life generally, both from the side of the advertiser and the consumer. With good design the customer is often tempted to buy more—therefore, the advertiser's profits increase: and, from an entirely different aspect, the witty and humorous work of such artists as Anders Beckman and Tom Eckersley (to mention just two among many) does so much to brighten the world around them.

In the past, little or no interest has been shown with regard to a company's 'public face' apart from its press and poster advertising. At last one sees a dawning realization that such items as letter-headings and labels play just as important a part in the advertiser's communication with the public as do his posters and press advertisements. In *Modern Publicity* there are a number of excellent examples of this co-ordination, and one can express only delight that such a trend has commenced. Long may it continue.

ASHLEY HAVINDEN

EARLY BIBLE ILLUSTRATIONS: A SHORT STUDY BASED ON SOME FIFTEENTH AND EARLY SIXTEENTH CENTURY PRINTED TEXTS. *By James Strachan. Cambridge, University Press, 1957. 18s 6d net*

Nearly eighty years have passed since Martin Conway, under the inspiration and patronage of Henry Bradshaw, studied the woodcuts in the early printed books of the Low Countries, and showed how their blocks were shifted from one book to another and one printer to another in the fifteenth and early sixteenth centuries. Mr. Strachan (who seems never to have heard of Conway) is an amateur, a former educational adviser to The Friends' Education Council; he brings to his book a refreshing enthusiasm that makes pages that might well have been dry both vivid and interesting.

His start was the illustrations in a copy of the Great Bible of Henry VIII, published in 1539; he worked backwards from this, and found himself led at once to Paris and thence to Venice, Nuremberg, Augsburg and Cologne. In his book he reverses the process of research, and shows how all these sources contributed to the illustrations of the Great Bible.

He begins with the engravings of the *Biblia Pauperum*, and does not go behind it to illuminated manuscripts. As a consequence, one has the feeling that his iconographic sequence has no real beginning; nor, since he does not mention such works as G. McN. Rushforth's *Mediaeval Christian Imagery*, does he relate the early engravings to contemporary stained glass and other works of art that must have been before the eyes of the Great Bible's readers.

Within his self-imposed limits Mr. Strachan has done his work well; it is precise and accurate, and provides a useful and interesting account of the pictures which even a Puritanical household might contain. The book is admirably produced. It is not easy to make greatly reduced reproductions of woodcuts; the only failure is the frontispiece, the title-page of the New Testament of the Great Bible. Its vast page has obstinately refused to be reduced.

JOAN EVANS.

DECORATIVE ART, 1957–58. VOLUME 47. *Edited by Rathbone Holme and Kathleen Frost. London, The Studio*, 1957. 35*s net.*

This international review of home furnishing and decoration is divided into seven sections—Houses and Apartments; Interiors and Furnishing; Textiles, Wallpapers and Carpets; Tableware and Silver; Glass; Lighting; Ceramics. The standard is not altogether even. The few houses included cannot be representative of the best recent domestic architecture, and the one beautiful example designed by Richard Neutra in California whets our appetite for more American work of the first class in which is achieved a quality of perfection, a sense of space and serenity, only to be found elsewhere in Japan.

Much of the decorative glass and the lighting will, in this reviewer's belief and hope, seem as peculiar and out of date in five years' time as Art Nouveau does now. But the section on interiors and furnishing, which is by far the largest and most important, is generally admirable; the examples are well and widely chosen and include many of timeless quality. The over-upholstered luxury flat has mercifully disappeared and the whole basis of selection has become more progressive—in fact, much more in line with Jaap Penraat's excellent leading article.

Yet again this capital book has more than maintained the high standard it has set for itself. It is an invaluable reference for everyone interested in the development of furnishing, and the Editors richly deserve the annual congratulation which has become their due.

R. D. R.

SHORT NOTES ON OTHER BOOKS

PLANT BREEDING AND GENETICS IN INDIA. 1. *By R. H. Richharia, Patna, Scientific Book Company*, 1957. 30*s*

Written principally for professional research workers and university students, this book, first published in 1945, is a systematic review of Indian scientific literature dealing with the improvement of Indian crops; the author's aim being to establish the link between plant geneticists and field and extension workers in the study of the Mendelian laws of inheritance and later developments. A number of revisions have been made to this second edition, and a further volume is promised, to cover work done since 1945.

SCIENCE AND ITS BACKGROUND. *By H. D. Anthony. London, Macmillan*, 1957. 20*s net*

In addition to numerous revisions, Dr. Anthony has added a new chapter on the International Geophysical Year to this third edition of a work of proven value to the general reader. It relates the development of scientific inquiry and achievement to the continuous history of human affairs, from the beginning of civilization to modern times. The work of individual scientists is examined not only for its own sake but as a contribution to general progress. There are many illustrations, and the time-charts are an illuminating aid to comprehension.

TIMBER IDENTIFICATION FOR THE BUILDER AND ARCHITECT. *By N. Clifford. London, Leonard Hill*, 1957. 37*s* 6*d net*

The economic implications of an ever-growing demand for timber by the building trade and other wood-consuming industries have made the matter of correct selection one of cardinal importance. In consequence of the prevailing scarcity of the better known and tried woods there is a need for reliable information about the less familiar species now imported. Mr. Clifford explains the principles of the subject, and supplies essential information about a wide range of timbers. The emphasis throughout is on identification, which is greatly assisted by the numerous illustrations, some in colour. There are indexes of alternative and botanical names. A practical textbook of value.

FROM THE JOURNAL OF 1858

VOLUME VI. *16th April*, 1858

LOOKING TO THE INTERNATIONAL EXHIBITION OF 1862

At a Special Meeting of the Council, held on Wednesday last, the 14th inst., the following resolutions were passed:

The Council of the Society of Arts, bearing in mind the part which the Society took in originating the Great Exhibition of 1851, have considered it to be their duty carefully to examine various suggestions for holding an Exhibition in 1861, which have been submitted to them, and have resolved:

1. That the institution of Decennial Exhibitions in London, for the purpose of showing the progress made in Industry and Art during each period of ten years, would tend greatly to the 'Encouragement of Arts, Manufactures, and Commerce'.

2. That the first of these exhibitions ought not to be a repetition of the Exhibition of 1851, which must be considered an exceptional event, but should be an Exhibition of works selected for excellence, illustrating especially the progress of Industry and Art, and arranged according to classes, and not countries; and that it should comprehend Music and also Painting, which was excluded in 1851.

3. That Foreigners should be invited to exhibit on the same conditions as British Exhibitors.

4. That the Council will proceed to consider how the foregoing resolutions can be best carried into effect.

[*This scheme eventually became the International Exhibition of 1862, with which the Society was even more closely concerned than it had been with the Great Exhibition of 1851. Though it was not a financial success, the 1862 Exhibition was in fact attended by a larger number of people than its famous predecessor, and included many more exhibitors.*]

Some Activities of Other Societies and Organizations

MEETINGS

TUES. 25 MARCH. Architects, Royal Institute of British, 66 Portland Place, W.1. 6 p.m. Eric Lyons: *Domestic building and speculative development.*

Carriage and Automobile Manufacturers, Institute of British, at Royal Society of Arts, W.C.2. 7 p.m. G. Langford Allen: *Resin/glass body work—achievement and prospects.*

WED. 26 MARCH. Foundrymen, Institution of British, at Constitutional Club, Northumberland Avenue, W.C.2. 7.30 p.m. B. Levy: *Pattern-making progress.*

The Building Centre, 26 Store Street, W.C.1. 12.45 p.m. Film Show: *The new tradition (multi-storied flats in No-Fines concrete).*

United Service Institution, Royal, Whitehall, S.W.1. 3 p.m. A. A. Shenfield: *The impact of reductions of defence requirements on British industry.*

Wool Education Society, at Royal Society of Arts, W.C.2. 7 p.m. T. J. Chandler: *The British wool hosiery industry, 1589–1958.*

MON. 31 MARCH. Engineers, Society of, at Burlington House, W.1. 5.30 p.m. A. H. Toms: *Soil in British railway civil engineering.*

Geographical Society, Royal, 1 Kensington Gore, S.W.7. 8.30 p.m. Thor Heyerdahl: *The enigma of Easter Island.*

TUES. 1 APRIL. Refrigeration, Institute of, at 14 Rochester Row, S.W.1. 5.30 p.m. Dr. G. G. Haselden: *An experimental study of the use of mixed refrigerants for obtaining cooling over a temperature range.*

WED. 2 APRIL. Central Asian Society, Royal, at Burlington House, W.1. 1.30 p.m. C. D. W. Savage: *A year in Mazanderan.*

Engineers, Junior Institution of, at James Watt Memorial Institute, Gt. Charles Street, Birmingham. Ladies' Night: Discussion: *Modern trends in kitchen housewares.*

SAT. 5 APRIL. Interplanetary Society, British, at Caxton Hall, S.W.1. 6 p.m. F. R. F. Taylor: *Problems of handling large missiles.*

TUES. 15 APRIL. Industrial Transport Association, at Royal Society of Arts, W.C.2. 6.30 p.m. J. C. Kendall: *Insurance in relationship to transport operation.*

Transport, Institute of, at 66 Portland Place, W.1. 5.45 p.m. C. F. B. Arthur: *The operation of tramp shipping.*

MON. 21 APRIL. Computer Society, British, at Caxton Hall, S.W.1. 6.15 p.m. Dr. Frank Yates: *The use of an electronic computer in research statistics—four years' experience.*

TUES. 22 APRIL. Japan Society, at Victoria & Albert Museum, South Kensington, S.W.7. 6 p.m. Captain M. D. Kennedy: *Communism in Japan.*

WED. 30 APRIL. Kinematograph Society, British, at Royal Society of Arts, W.C.2. 7.15 p.m. Television Division meeting: *An instantaneous electronic colour film analizer.*

OTHER ACTIVITIES

NOW UNTIL THURS. 3 APRIL. 16–17 Hay Hill, W.1. Mon. to Fri. 10 a.m. to 5 p.m. Sat. 10 a.m. to 12.30 p.m. *Exhibition of Fine Crafts.* Also, *Pottery by Shoji Hamada.*

TUES. 25 MARCH to SAT. 29 MARCH. The Building Centre, at Engineering Centre, Stephenson Place, Birmingham, 2. 9 a.m. to 5 p.m. daily. Exhibition: *Recent new building materials.*

Fellows and Associates are reminded that they may borrow up to five books at a time from the library and retain them for a month. Members living outside London may borrow books by post. Books sent by post are despatched at the cost of the Society and returned at the cost of the borrower.

LIBRARIES, MUSEUMS AND SOCIETIES

ASHWORTH, WILFRED, *editor*—Handbook of special librarianship and information work. *London, Aslib*, 1955.

*LONDON, BRITISH MUSEUM—Catalogue of maps, prints, drawings, etc., forming the geographical and topographical collection attached to the library of his late Majesty King George III and presented by His Majesty King George IV to the British Museum. *London, British Museum*, 1829.

LONDON, BRITISH MUSEUM—A descriptive catalogue of early prints in the British Museum; German and Flemish schools, by William Hughes Willshire. *London, British Museum*. Vol. I, 1879; Vol. II, 1883.

LONDON, BRITISH MUSEUM—Catalogue of seals in the department of manuscripts in the British Museum by W. de Gray Birch. *London, British Museum*. Vol. I, 1887; Vol. II, 1892; Vol. III, 1894; Vol. IV, 1895; Vol. V, 1898; Vol. VI, 1900.

LONDON, BRITISH MUSEUM—Catalogue of early German and Flemish woodcuts preserved in the department of prints and drawings in the British Museum, by Campbell Dodgson. *London, British Museum*. Vol. I, 1903; Vol. II, 1911.

LONDON, SCIENCE MUSEUM—The Science Museum: the first hundred years. *London, H.M.S.O.*, 1957.

EXHIBITIONS

GLASGOW, 1901: DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION FOR IRELAND—Ireland, industrial and agricultural: handbook for the Irish pavilion, *Glasgow, International Exhibition*, 1901.

MILAN, 1956: Premio la Rinascente compasso d'oro per l'estetica del prodotto. *Milan, La Rinascente*, 1957. Presented by Mr. Augusto Morello.

SCIENCE

ANTHONY, HERBERT DOUGLAS—Science and its background. 3rd edition. *London, Macmillan; New York, St. Martin's Press*, 1957.

ROYAL SOCIETY OF LONDON—The United Kingdom contribution to the International Geophysical Year, 1957–58. *London, Royal Society*, 1957.

CRAFTS AND LIGHT MANUFACTURES

LOMAX, ABRAHAM—Royal Lancastrian pottery, 1900–1938: its achievements and its makers. *Ainsworth House, Breightmet, Bolton; Lomax*, 1957.

ARCHITECTURE AND BUILDING (including Town Planning)

BOE, ALF—From Gothic revival to functional form: a study in Victorian theories of design. *Oslo, Oslo University Press; Oxford, Blackwell*, 1957. (Oslo studies in English, No. 6.)

CLIFFORD, NICHOLAS—Timber identification for the builder and architect. *London, L. Hill*. 1957.

COUNCIL FOR THE PRESERVATION OF RURAL ENGLAND—Your house on view. *London, Council for the preservation of rural England*, 1957.

GODFREY, WALTER HINDES—The English almshouse, with some account of its predecessor, the medieval hospital. *London, Faber*, 1955.

GUTHEIM, FREDERICK—One hundred years of architecture in America, 1857–1957: celebrating the centennial of the American Institute of Architects. *New York, Reinhold: [London, Chapman & Hall]* 1957.

MEEKS, CARROLL L. V.—The railway station, an architectural history. *London, Architectural Press; New Haven, Yale University Press*, 1957.

SMITH, EARL BALDWIN—Architectural symbolism of Imperial Rome and the Middle Ages. *Princeton (N.J.), Princeton University Press; London, Oxford University Press* 1956. (Princeton monographs in art and archæology, No. 30.)

SUDELL, RICHARD *and* WATERS, DAVID TENNYSON—Sports buildings and playing fields. *London, Batsford*, 1957.

WEBB, GEOFFREY [FAIRBANK]—Architecture in Britain: the Middle Ages. *Harmondsworth, Penguin Books*, 1956. (Pelican History of Art series, edited by Nikolaus Pevsner.)

INDUSTRIAL AND COMMERCIAL ART AND DESIGN

ANGRAVE, BRUCE—Sculpture in paper. *London, Studio Publications*, 1957. (How To Do It series, No. 72.)

CONRAN, TERENCE—Printed textile design. *London, Studio Publications*, 1957. (How To Do It series, No. 74.)

EDWARDS [HERBERT CECIL] RALPH, *and* RAMSEY, LEONARD GERALD GWYNNE, *editors*—The Connoisseur period guides to the houses, decoration, furnishing and chattels of the classic periods. *London, Connoisseur*, 1957. (The Stuart period, 1603–1714; The early Georgian period, 1714–1760.)

ELLENBOGEN, EILEEN—English vinaigrettes. *Cambridge, Golden Head Press*, 1956.

HARRISON, T. ERAT *and* TOWNSEND, W. G. PAULSON—Some terms commonly used in ornamental design, their application defined and explained with illustrations. *London, Batsford*, 1906.

PINE, LESLIE GILBERT—Heraldry and genealogy; illustrated by W. J. Hill. *London, English Universities Press* [1957]. (Teach yourself books, edited by Leonard Cutts.)

SPARROW, WALTER SHAW—Advertising and British art, an introduction to a vast subject. *London, John Lane* (1924).

STRANGE, THOMAS ARTHUR—An historical guide to French interiors, furniture, decoration, woodwork and allied arts; during the last half of the seventeenth century, the whole of the eighteenth century and the early part of the nineteenth. *London, McCorquodale* (1950).

WALLACE COLLECTION, *London*—Furniture: text, with historical notes and illustrations, by F. J. Watson. *London, Wallace collection*, 1956.

COSTUME

CUNNINGTON, CECIL WILLETT, *and* CUNNINGTON, PHILLIS—Handbook of English costume in the eighteenth century; with illustrations by Barbara Phillipson and Phillis Cunnington. *London, Faber*, 1957.

FINE ARTS (GENERAL)

BEDDINGTON, JACK, *compiler*—Young artists of promise; chosen and introduced by Jack Beddington. *London, Studio Publications*, 1957.

BRIEGER, PETER—English art, 1216–1307. *Oxford, Clarendon Press*, 1957. (Oxford history of English art, edited by T. S. R. Boase, Vol. 4.)

* Books marked with an asterisk are part of the reference library and are not normally available for loan.

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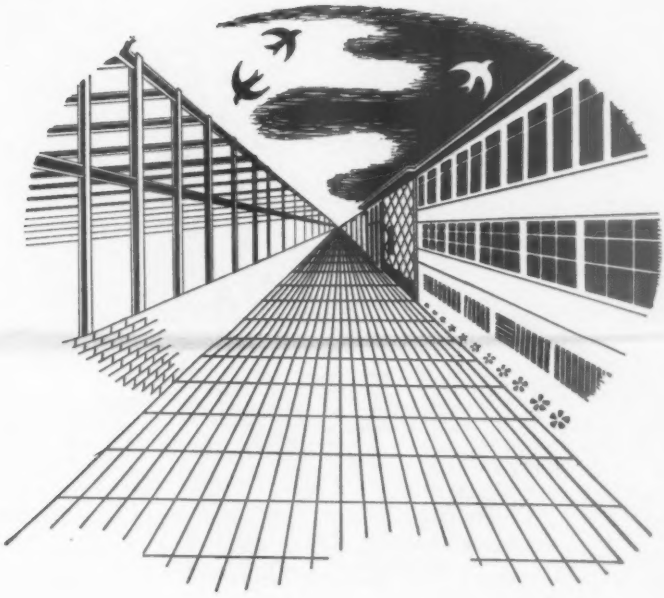

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